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MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

DRAFT ENVIRONMENTAL IMPACT STATEMENT

RESOURCE APPENDICES

MARCH 2002

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Project Area
COAL CREEK STATE FOREST
Whitefish
Columbia Falls
Moose Fire Salvage and Restoration Project
Coal Creek State Forest
Vicinity Map
MONTANA DNRC
Moose Fire Perimeter
State of Montana (DNRC) Ownership
Streams
Roads
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INTRODUCTION TO RESOURCE APPENDICES FOR THE MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

The following appendices are a part of the Moose Fire Salvage and Reforestation Project - Phase II DEIS (bound separately). The Interdisciplinary Team members prepared the resource appendices; the discussions include citations from other sources such as research documents, environmental assessments, etc. The lengthy technical discussions of methodologies, research, monitoring, baseline studies, analyses, etc., completed by the Interdisciplinary Team are presented in these appendices. The information in the appendices would need to be utilized for any scientific, technical, or legal review.

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MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

RESOURCE APPENDIX A
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Appendix B

Stipulations and Specifications

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

APPENDIX B

STIPULATIONS AND SPECIFICATIONS

Stipulations and specifications for the action alternatives were identified or designed to prevent or reduce potential effects to resources considered in this analysis. In part, stipulations and specifications are a direct result of issue identification and resource concerns. This section is organized by resource.

Stipulations and specifications that apply to operations required by, and occurring during, the contract period would be contained within the Timber Sale Contract. As such, they are binding and enforceable. Project administrators would enforce stipulations and specifications relating to activities such as hazard reduction, site preparation, and planting that may occur during or after the contract period.

The following stipulations and specifications would be incorporated into the selected action alternative to mitigate potential effects on resources.

TABLE OF CONTENTS

Watershed and Fisheries 1
Bald Eagles 2
Grizzly Bears 2
Wolves 3
Snag Retention 3
Aesthetics 3
Air Quality 3
Soils 4
Noxious Weed Management 5
Archaeology 5

WATERSHED AND FISHERIES

- Erosion control measures planned include:
  - grade breaks on roads,
  - surface-water-diverting mechanisms on roads,
  - slash-filter windrows, and
  - grass seeding.

  Details for these control measures will be included in Appendix B of the Timber Sale Agreement.
- Culvert sizing for all road projects will be for a 50-year-flood event, as recommended by the DNRC hydrologist.
- Stream crossings where culvert removals and installations are planned will have the following requirements, as needed, to protect water-quality and meet BMPs:
  - Filter-fabric fences will be in place downstream prior to and during culvert installation.
  - Diversion channels will be constructed and lined with plastic to divert streamflow prior to any in-channel operations.
- Contract requirements for bridge removal and installation include:
  - Crossings would be limited and occur only at authorized sites.

- All soil disturbed during installation or removal of bridges will be seeded with quick-cover mix within 24 hours of disturbance.

- Brush would be removed from existing road prisms to allow effective road maintenance. Road maintenance would reduce sediment delivery.

- The contractor would be responsible for the immediate cleanup of any spills (fuel, oil, dirt, etc.) that may affect water quality.

- Leaking equipment would not be permitted to operate at stream-crossing construction sites.

Included in the project proposal are the following pertinent recommendations of the Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program Final Report, June 1991.

The following numbers correspond to the numbering of recommendation items contained within the aforementioned document, included in pages 154-162 of the final report.

1. BMPs are incorporated into the project design and operations of the proposed project.

2. Riparian indicators will be considered in the harvest unit layout.

3. Management standards of the SMZ Law (75-5-301, MCA) are used in conjunction with the recommendations of the study.

4. The BMP audit process will continue. This sale will likely be reviewed in an internal audit and may be picked at random as a Statewide audit site.

7. SMZs will be evaluated as a part of the audit process.

11. Swift Creek monitoring is part of the Flathead Basin monitoring effort.

12. Watershed-level planning and analysis is complete. Logging plans of other agencies and private companies are used.

15. DNRC will use the best methods available for logging and road building for this proposal.

16A. Existing roads are fully utilized for this proposal.

17. DNRC requested inventory information from DFWP. DNRC's mitigation plan for roads fits all recommendations for "impaired streams". Using "worst case scenario" criteria provides for conservative operations in this proposal.

18. Provisions in the Timber Sale Agreement address BMPs that are rigidly enforced.

20. Planning for long-term monitoring of Swift Creek is in place.

29-34. DNRC has cooperated with DFWP to continue fisheries work. DNRC will continue to monitor fisheries in the future as funding allows.

BALD EAGLES

No harvesting or yarding activity will occur in the primary use area or across documented flight paths.

GRIZZLY BEARS

The following items are incorporated into this proposal:

- Grass seeding plans to revegetate roads and landings include seeding with plant species less palatable to grizzly bears to discourage or minimize the potential for bear/ human conflicts.

- No logging camps would be allowed in the sale area.

- Garbage hauling would be required daily.

- The Forest Officer would immediately suspend any or all activities directly related to the

proposed action, if necessary, to prevent imminent confrontation or conflict between grizzly bears, or other threatened or endangered species, and humans.

- While working under contract, contractors will be prohibited from carrying firearms onto restricted roads.
- All restricted roads will be closed by a gate, if present, or by a sign and sawhorse placed in the middle of the road while logging operations are inactive (weekends, night, etc.).
- Following harvesting operations, temporary roads will be obliterated by recontouring, slashing, or otherwise obscuring the road prism for at least 200 feet. The remaining road prism behind the obliteration would be ripped and water barred. The obliteration should be at a level to prevent motorized use.

WOLVES

A contract provision will require DNRC to contact USFWS to develop and implement mitigations to protect any wolf den or rendezvous site within the gross sale area that may be discovered during implementation of this proposal.

SNAG RETENTION

- Two to five trees or snags per acre average 15 inches dbh or greater.
- Larger trees that are 200 feet from an open road would be favored.
- Trees less than 7 inches diameter inside the bark at a height of 16.5 feet, or, in lodgepole pine stands, 5.6 inches in diameter inside the bark at a height of 16.5 feet. This will be done administratively.
- Cull trees/snags with over 67 percent defect would be left.
- Western larch and Douglas-fir would be favored for retention.
- Clumpy distribution, versus even distribution, would be favored.

AESTHETICS

- The number and size of landings will be limited; the location will be away from main roads, when possible.
- Disturbed sites along road right-of-ways will be grass seeded.

AIR QUALITY

- To prevent individual or cumulative effects during burning operations, burning will be done in compliance with the Montana Airshed Group reporting regulations and any burning restrictions imposed in Airshed 2. This will provide for burning during acceptable ventilation and dispersion conditions.
- To reduce effects from burning operations:
  - excavator, landing, and roadwork debris will be piled clean to allow ignition to occur during fall and spring when ventilation is good and surrounding fuels are wet. The Forest Officer may require that piles be covered to reduce dispersed (unentrained) smoke. Covered piles are drier, ignite easier, burn hotter, and extinguish sooner.
  - the number of burn piles would be minimized by leaving the large woody debris on site.
- Dust abatement may be applied on some segments of Upper and Lower Whitefish roads used during hauling, depending on the season and level of public traffic.

SOILS

Compaction

- Logging equipment will not operate off forest roads unless soil moisture is less than 20 percent,

frozen to a depth that will support machine operations, or snow covered to a depth that will prevent compaction, rutting, or displacement.

- Existing skid trails and landings will be used if their design is consistent with prescribed treatments and meets current BMP guidelines.
- Designated skid trails would be required where moist soils or short steep pitches (less than 300 feet) would not be accessed by other logging systems. This would reduce the number of skid trails and the potential for erosion.
- The logging foreman and sale administrator will agree to a general skidding plan prior to equipment operations.
- The density of skid trails in a harvest area will not exceed 20 percent of the total area in a cutting unit.

Soil Displacement

Conventional ground-based skidding equipment will not be operated on slopes steeper than 40 percent. Soft-tracked yarders have less impact than conventional tractor skidding on slopes up to 55 percent. Cable yarding would be used on steeper slopes.

Erosion

- Ground-skidding machinery will be equipped with a winchline to limit the amount of equipment operation on steeper slopes.
- To reduce surface erosion, roads used by the purchaser will be reshaped and the ditches redefined following use to reduce surface erosion.
- Drain dips and gravel will be installed on roads, as needed, to improve road drainage and reduce maintenance needs and erosion.
- Some sections of roads will be repaired to upgrade the roads to the design standards that reduce erosion potential and maintenance needs.
- The prompt and timely application of certified weed-free grass seed and fertilizer would be applied to all newly constructed road surfaces, cut-and-fill slopes, *and* any existing disturbed cut-and-fill slopes and landings immediately adjacent to open roads. This would be done to stabilize soils and reduce/prevent the establishment of noxious weeds and would include:
  - seeding all road cuts and fills concurrently with construction;
  - applying "quick cover" seed mix at culvert installation sites within 1 day of when work is completed; and
  - seeding all road surfaces and reseeding culvert installation sites when the final blading is completed for each specified road segment.
- As directed by the Forest Officer, water bars, logging-slash barriers, and, in some cases, temporary culverts will be installed on skid trails where there is a potential for erosion, based on ground and weather conditions. These erosion-control features will be periodically inspected and maintained throughout the contract period or extensions thereof.

NOXIOUS WEED MANAGEMENT

- Surface blading may be required to remove weeds before the seed-set stage on roads affected by the proposal.
- All tracked and wheeled equipment are required to be clean of noxious weeds prior to beginning project operations. The contract-administrating officer will inspect equipment periodically during project implementation.

- Prompt revegetation of disturbed roadside sites would be required. Roads used and closed as part of this proposal would be reshaped and grass seeded.

ARCHAEOLOGY

- A review of the project was conducted by a DNRC archaeologist.
- A contract clause provides for suspending operations if cultural resources are discovered; operations may only resume as directed by the Forest Officer.

Appendix C

Hydrology Analysis

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

APPENDIX C
WATERSHED AND HYDROLOGY ANALYSIS

INTRODUCTION

WATER QUALITY

The primary parameter of concern for water quality is sediment. Increased sediment delivery and deposition can affect physical and biological water quality, channel stability, and geomorphology. Sediment delivery can be affected by a number of activities. Timber harvesting and associated road construction can increase sediment delivery to streams through exposure of bare soil. These impacts can be mitigated through implementation of Best Management Practices (BMPs), and other erosion-control measures. Wildfires can also increase sediment yield by creating bare soil on steep slopes and along creeks.

Other parameters of concern for water quality are stream water temperature and nutrient levels. Higher concentrations of nutrients such as nitrogen and phosphorus can lead to algae blooms in streams and lakes. Vegetative removal can decrease levels of shade and, therefore, can lead to increases in stream temperature. Elevated stream temperatures encourage algae blooms and can affect beneficial uses, such as salmonid fisheries.

WATER YIELD

Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed. Similarly, a stand-replacement wildfire also affects water quantity and yield in a watershed. Water yields increase proportionately to the percentage of canopy removal, because removal of live trees reduces the amount of water transpired, leaving more water available for soil saturation and runoff. Canopy removal also decreases interception of rain and snow and alters snowpack distribution and snowmelt, which lead to further water yield increases. Higher water yields may lead to increases in peak flows and peak-flow duration, which can result in accelerated streambank erosion and increased sediment yields.

ANALYSIS METHODS

Existing conditions for water yield were analyzed using the equivalent clearcut acre (ECA) method as described in Forest Hydrology Part II (*Haupt, 1974*). This analysis was conducted in 2002 to analyze the impacts of past management and the recent wildfires on the Coal Creek watershed. The ECA method of calculating water yield was run using a spreadsheet program to

Table of Contents

Introduction 1
Analysis Methods 1
Analysis Area 2
Existing Conditions 2
Alternative Effects 6

compute projected changes in water yield. Channel-stability data were also gathered to determine the existing status of the streams in the proposed project area. Procedures used are outlined in Forest Hydrology Part II (*Haupt, 1974*).

ANALYSIS AREA

WATER QUALITY

The analysis area for water quality is the Coal Creek watershed and all roads that lead into Coal Creek State Forest from other ownership. The primary focus of the sediment-delivery analysis will be on the Coal Creek, Cyclone Creek, and Dead Horse Creek portions of Coal Creek State Forest. Coal Creek is a perennial fourth-order tributary to the North Fork of the Flathead River. The Coal Creek watershed drains approximately 52,471 acres. Elevation ranges from 3,400 feet at the North Fork of the Flathead River to 7,445 feet. Precipitation ranges from approximately 25 inches in the valley bottom to 75 inches in the upper elevations. Cyclone Creek is an 8,353-acre perennial tributary to Coal Creek. Dead Horse Creek is a 6,588-acre perennial tributary to Coal Creek. DNRC owns approximately 4,826 acres (9 percent) in Coal Creek. Approximately 700 acres are owned privately in the Coal Creek watershed, and FNF owns the remainder of the watershed.

WATER YIELD

The analysis area for water yield is the Coal Creek watershed. The analysis will focus on the Cyclone Creek, Lower Coal, and Dead Horse portions of the Coal Creek watershed since these watersheds were the only portions of the Coal Creek watershed affected by the Moose fire.

EXISTING CONDITIONS

REGULATORY FRAMEWORK

Montana Surface Water Quality Standards: According to the Administrative Rules of Montana (ARM) 17.30.608 (1), the Coal Creek drainage and its tributaries are all classified as B-1. Among other criteria for B-1 waters, no increases are allowed above naturally occurring levels of sediment, and minimal increases over natural turbidity. "Naturally occurring," as defined by ARM 17.30.602 (17), includes conditions or materials present during runoff from developed land where all reasonable land, soil, and water conservation practices (BMPs) have been applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after completion of potentially impactive activities.

Designated beneficial water uses within the project area are located in the Coal Creek watershed (including Dead Horse and Cyclone creeks). These beneficial uses include domestic water supply, irrigation, and power generation (all in Cyclone Creek), and cold-water fisheries and aquatic life support (entire Coal Creek watershed).

Water Quality Limited Waterbodies: Coal Creek is currently listed as a water quality limited waterbody in the 1996 and 2000 303(d) list. The 303(d) list is compiled by DEQ as required by Section 303(d) of the Federal Clean Water Act and the Environmental Protection Agency (EPA) Water Quality Planning and Management Regulations (40 CFR, Part 130). Under these laws, DEQ is required to identify waterbodies

that do not fully meet water-quality standards or where beneficial uses are threatened or impaired. These waterbodies are then characterized as "water-quality limited" and thus targeted for Total Maximum Daily Load (TMDL) development. The TMDL process is used to determine the total allowable amount of pollutants in a waterbody of watershed. Each contributing source is allocated a portion of the allowable limit. These allocations are designed to achieve water-quality standards.

The Montana Water Quality Act (MCA 75-5-701-705) also directs the DEQ to assess the quality of State waters, Ensure that sufficient and credible data exists to support a 303(d) listing, and develop TMDL for those waters identified as threatened or impaired. Under the Montana TMDL Law, new or expanded nonpoint-source activities affecting a listed waterbody may commence and continue provided they are conducted in accordance with all reasonable land, soil, and water conservation practices. TMDLs have not been completed for the Coal Creek drainage. DNRC will comply with the Law and interim guidance developed by DEQ through implementation of all reasonable soil and water conservation practices, including BMPs and Resource Management Standards as directed under the SFLMP.

The listed cause of impairment in Coal Creek is siltation, with the probable sources listed as silviculture, logging road construction and maintenance, and highway/road runoff.

Montana (SMZ) Law: By the definition in ARM 36.11.301 (2c), the majority of the Coal Creek watershed is a class 1 stream. Coal, Cyclone, and Dead Horse creeks, and many of their tributaries, have surface flow for more than 6 months each year. Stream reaches in Coal, Cyclone, and Dead Horse creeks also support fish. Some of the smaller first-order tributaries may be classified as class 2 or 3 based on site-specific conditions.

WATER QUALITY

Existing conditions for sediment delivery prior to the Moose Fire are described in the Cyclone/Coal Timber Harvest Project EIS. When this project was analyzed in 1998, several existing and potential sources of sediment were identified in the analysis. With the exception of the South Coal road system in Section 28, 29, and 30, all proposed road improvements discussed in the Cyclone/Coal Timber Sale Project EIS were completed either through the Coal '99 Timber Sale Project Contract or the fire rehabilitation efforts. The bridge over Coal Creek (Section 28, T34N, R21W), referred to as the Dead Horse bridge, has also been replaced and meets all applicable BMPs. In addition to the surface drainage features installed through the Coal '99 Timber Sale Project, fire rehabilitation efforts have installed new culverts on several stream and draw crossings in the lower Coal Creek watershed during the fall of 2001. These culverts were replaced with larger structures to carry the higher runoff events likely to occur as a result of the stand-replacement fire. Additional ditch-relief culverts have also been installed on all roads in the proposed salvage area to accommodate expected higher runoff and overland flow from the burned areas.

Due to the Moose Fire, sediment delivery from existing roads is expected to increase from past levels. This increase is a result of increased runoff from upland areas and due to the burning of ground cover vegetation on existing road surfaces, cuts, and fills.

Erosion and sediment delivery are expected to increase from within the moderate-and high-severity burn areas located in and around the proposed project area. Therefore,

additional direct impacts to water quality and direct and indirect impacts to downstream beneficial uses are anticipated in the Coal Creek watershed (including Cyclone and Dead Horse creeks). The amount of sediment delivery and subsequent impacts to water quality resulting from the recent wildfires are expected to be substantial. According to the BAER report for the Moose fire, ash from the fire may increase nutrient levels by 2 to 3 times the present levels, but, "It should not be a problem for the aquatic systems within or just outside of the fire." The BAER report also states that, due to wide flood plain storage areas and wetland and beaver pond complexes, most sediment generated from upslope areas should settle out in these areas and minimize downstream sediment deposition. This risk of sediment deposition will decrease in 2002 as ground cover vegetation continues to recover.

In addition, there will be substantial inputs of large woody material into these creeks as burned trees continue to fall across streams. This woody material input may create short-term bank scour by deflecting flows, but will have a long-term effect of stabilizing the channel. Large woody material creates sediment storage, and reduces the erosive power of streams. This input will also benefit fish habitat over the long term. Due to the stand-replacement nature of the fire on several reaches of Dead Horse and Coal creeks, the large woody material left by the Moose fire will be the only recruitment of large woody debris for 80 to 100 years.

Hydrophobic soils in the Coal Creek watershed are no longer present. The only soils physically altered by the fire were in the Big Creek drainage. The remainder of the hydrophobic soils consists of volcanic ash surface soils that were severely dried by the fire. This hydrophobic condition is generally relieved by approximately 0.5 inches of precipitation. The Coal Creek watershed has already received this amount of moisture and has begun to absorb water with fall rains and winter snow.

Additional direct sediment delivery to Coal Creek and its tributaries may occur through the increased risk of debris flows and mass soil movements following the fire. These events could potentially deliver catastrophic volumes of sediment to the streams on an isolated basis. Proximity to the creek would determine the level of risk for delivery.

Temperature data in Coal Creek collected by FNF show the maximum stream temperature was 14.5 degrees centigrade between 1984 and 1995. This is adequate to support beneficial uses in Coal Creek, including cold-water fisheries. See the fisheries analysis for a more detailed assessment of cold-water fishery habitat. Increases in monthly mean stream temperatures are likely in Coal Creek due to the amount of streamside vegetation that was burned off by the fire. Solar radiation to the streams will be increased, and subsequent increases in stream temperature will follow until streamside vegetation is established.

WATER YIELD

Timber harvesting and associated road-construction activities have taken place in the Coal Creek watershed since the 1950s. All harvested stands have undergone varying degrees of vegetative recovery. Some of the harvested stands were burned by the Moose fire, which has set these stands back to the beginning of vegetative recovery. All burned stands were accounted for in a water-yield calculation completed in 2002 by a DNRC hydrologist. The water-yield analysis is a cumulative summary of

TABLE C-1 – 2002 WATER YIELD INCREASES IN COAL CREEK WATERSHED AND TRIBUTARIES

WATERSHED	ACRES	PREFIRE %WYI	POSTFIRE %WYI*
Cyclone	8,353	3.6	6.0
South Coal	11,802	2.5	2.5
Upper Coal	14,981	3.2	3.2
Dead Horse	6,588	1.5	21.1
Lower Coal	10,749	1.4	15.8
Coal Creek	52,473	2.7	7.1

**%WYI = average annual increase in water yield over an undisturbed, fully forested condition.*

management and fire effects in the Coal Creek watershed. *TABLE C-1 – 2002 WATER YIELD INCREASES IN COAL CREEK WATERSHED AND TRIBUTARIES* shows the effects of the Moose fire, past and ongoing timber management on each of the 5 subwatersheds in Coal Creek, and on the entire Coal Creek watershed.

Channel stability data were gathered on Cyclone Creek and Coal Creek in 1997 in conjunction with the Cyclone/Coal Timber Harvest Project EIS. Channels were found to be in fair to good condition. Follow-up assessment of Coal and Cyclone creeks following the Moose Fire show that channel stability has not changed since the 1997 assessments.

As shown in *TABLE C-1 – 2002 WATER YIELD INCREASES IN COAL CREEK WATERSHED AND TRIBUTARIES*, vegetation killed by the Moose Fire led to water yield increases in the Dead Horse Creek, Cyclone Creek and Lower Coal Creek watersheds. *TABLE C-2 – MOOSE FIRE BURN SEVERITY BY WATERSHED* lists the burn severity by watershed for the Moose Fire. The BAER report for the Moose Fire stated that water-yield increases and the associated sediment yield in Dead Horse Creek are anticipated to be buffered by the wetland and beaver pond complex near its confluence with Coal Creek. Dead Horse Creek and the lower reaches of Coal Creek are expected to exhibit

TABLE C-2 – MOOSE FIRE BURN SEVERITY BY WATERSHED

BURN SEVERITY	LOWER COAL	CYCLONE	DEAD HORSE	UPPER COAL	SOUTH COAL	TOTAL
High	283	0	52	0	0	335
Moderate	4,166	690	2,252	0	0	7,108
Low	404	0	108	0	0	512
Low/Mosaic	1,252	1,673	1,420	0	0	4,345
Unburned	1,779	54	144	0	0	1,977
Total	7,884	2,417	3,976	0	0	14,277

TABLE C-3 – REGIONAL FLOOD FREQUENCY PREDICTIONS

WATERSHED	PREFIRE			POSTFIRE[1]		
	Q_2[2] (cfs)[3]	Q_{10}[4] (cfs)	Q_{50} (cfs)	Q_2 (cfs)	Q_{10} (cfs)	Q_{50}[5] (cfs)
Dead Horse	117	232	335	158	313	452
Unnamed Creek	59	123	182	86	178	264
Cyclone	123	247	358	133	267	387
Coal Creek	820	1,460	1,985	935	1,664	2,263

[1] Postfire increase was calculated assuming a 1 percent increase in flow for each 1 percent of watershed area with high- or moderate-burn severity.
[2] A flood event with a 2-year recurrence interval.
[3] Flow in cubic feet per second.
[4] A flood event with a 10-year recurrence interval.
[5] A flood event with a 50-year recurrence interval.

in-channel scour as a result of the increases in water yield. This will change the geomorphology of these creeks, possibly destabilizing banks and increasing the risk of failure of existing debris jams in the channels.

In addition to the projected water-yield increases by the ECA method, the BAER team calculated projected storm-flow responses for Dead Horse Creek and an unnamed tributary to Coal Creek in the southeast portion of the Lower Coal watershed (referred to as Swamp Creek in BAER report). *TABLE C-3 REGIONAL FLOOD-FREQUENCY PREDICTIONS* shows the results of these computations, along with computations completed by a DNRC hydrologist using the same methodology (*Omang, 1992*), for Cyclone and Coal creeks at their confluence with the North Fork of the Flathead River.

ALTERNATIVE EFFECTS

DIRECT AND INDIRECT EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A***

  Direct and indirect effects of No-Action Alternative A would be similar to the impacts described under the existing conditions for sediment, nutrients, water yield, and water temperature. Existing levels of snags would remain available for large woody debris recruitment to streams and draws and on upland slopes. These snags would remain on site and fall as dictated by climatic conditions. Logs that fall on upper and middle slopes would provide some protection for bare soil from rilling and overland flow.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E***

  No substantial effects to water yield are expected from Action Alternatives B, C, D, or E. All trees proposed for removal were killed by the Moose fire and are no longer transpiring water from the ground or providing substantial levels of snow interception in the canopy. The proposed action alternatives would pose minimal risk of debris flow or mass wasting beyond those risks described in the existing conditions portion of this analysis.

  All action alternatives propose some yarding with helicopters. Helicopter yarding would generate ground disturbance on 5 percent of the area within proposed units, with a negligible risk of sediment generation or delivery.

  Indirect effects of all action alternatives would include removal of future downed woody material from the salvaged stands. Large downed logs provide erosion control on slopes, so the risk of rilling and overland flow would increase with the action alternatives. Retention of submerchantable trees, slash, and tops on salvaged sites should provide protection to slopes and minimize this risk. Slash retention, combined with SMZ retention and equipment restriction zones, should prevent sediment delivery to streams. No other indirect effects would be generated from the proposed Action Alternatives B, C, D or E. The remainder of the indirect effects would be similar to those discussed in the existing conditions.

- ***Direct and Indirect Effects Common to Action Alternatives B and C***

  No additional or substantial effects to water quality are expected from Action Alternatives B or C. Direct effects of these alternatives would be similar to the effects described in the existing conditions. No timber salvage would occur within 100 feet of a fish-bearing stream, and no equipment would be operated within 125 feet of a fish-bearing

stream. In most cases, SMZ boundaries are located more than 125 feet from class 1 fish-bearing streams. This retention would ensure long-term recruitment of large woody material to the streams and leave large woody material levels similar to those discussed in the existing conditions. All other streams would be laid out according to the SMZ Law and Resource Management Standard 10 of the SFLMP. Non-fish-bearing streams would retain a minimum of 50 percent of the trees, and no live green trees would be cut.

Ground-based yarding would take place in summer conditions on approximately 688 acres with Action Alternative B and 683 acres with Action Alternative C. Ground conditions required to use ground-based machinery are discussed in the soils analysis. Units 3DH, 6CM, 25W, 27W, and 29W are located near a perennial stream channel and proposed for ground-based yarding. Unit 3DH is located near Dead Horse Creek, Unit 6CR is located near an intermittent tributary to Cyclone Creek, Unit 6CM is near Cyclone Creek and a perennial tributary to Cyclone Creek, and Units 25W, 27W and 29W are located near a perennial tributary to Cyclone Creek. Most of the areas in these units are level to gentle terrain and would have a low risk of adverse impacts to water quality. Use of ground-based equipment would increase the risk of soil disturbance and sediment delivery to these creeks, but this risk would be minimized through skid trail design and placement of water bars and slash in trails to provide erosion control (*McIver 2000*). According to a study completed by *Chou (1994)*, no changes in sedimentation were found after postfire logging when compared to control watersheds. Erosion and sediment delivery are not expected to increase substantially provided skid-trail spacing, equipment-restriction zones, and soil-moisture limits are all kept within the recommended levels. Refer to the soils analysis for soil disturbance estimates and for additional operating requirements on these units.

Action Alternatives B and C also propose downhill cable yarding on approximately 107 and 82 acres, respectively. Soil disturbance may occur in the yarding corridors where full suspension is not possible. Places where logs drag partially on the ground can be subject to soil disturbance. Corridors would have water bars and slash placed to reduce the risk of rill erosion following yarding completion. Risk of sediment delivery is low in these units since none are located near a stream. Unit 13W and portions of Unit 29W are proposed for downhill cable yarding.

The remainder of Action Alternatives B and C would be yarded with helicopters.

Action Alternatives B and C each propose 3 temporary stream crossings:

- a 40-foot portable bridge over Cyclone Creek in Section 35, T34N, R21W,
- a 30-foot portable bridge over an unnamed perennial tributary to Cyclone Creek in Section 36, T34N, R21W, and
- a 40-foot portable bridge over Dead Horse Creek in Section 34, T34N, R21W.

Each of these proposed crossings would use a portable bridge designed to span the existing streambank and would be removed upon completion of the salvage operations. The existing streambanks would not be disturbed. Each crossing would be designed to meet all applicable

BMPs and would comply with the SMZ Law and requirements of 124 permits issued by the FWP.

Approximately 3.4 miles of new temporary low-standard road would be constructed with Action Alternatives B and C. These roads would involve minimal cut and fill, be located well away from streams, and be reclaimed after use. Reclamation would include partial recontouring, installation of water bars and slash, and grass seeding. In addition, some segments of these roads would be recontoured to make the road surface unusable by motorized vehicles. None of these roads would be constructed on steep sideslopes or located on sensitive soil types prone to mass movement. These roads would all meet applicable BMP standards and have a low risk of sediment delivery.

Nutrient levels are not expected to change in any of the streams in the proposed project area as a result of the salvage activities. Nutrients such as phosphorus and nitrogen are attached to soil particles. If these particles are delivered to a stream, the nutrients may dissolve in the water and increase nutrient levels in the stream. The risk of sediment delivery to a stream from proposed harvesting activity is expected to be low, so associated risk of nutrient increases would also be low.

- ***Direct and Indirect Effects of Action Alternative B***

  In addition to the effects described in the previous sections, Action Alternative B would salvage an additional 4 acres in Unit 6CR and 12 acres in Unit 13W. Unit 6CR is located near an intermittent tributary to Cyclone Creek and conventional ground-based equipment would be used. The terrain is gentle, and would present a low risk of sediment delivery to the intermittent stream. Soil disturbance would be minimized through skid-trail design; placing water bars and slash in skid trails would minimize the risk of sediment delivery. The additional 12 acres in Unit 13W are not located near a creek and would be yarded with cable equipment. Skyline yarding corridors would have water bars and slash placed to reduce the risk of rill erosion following completion of yarding. The risk of sediment delivery from Unit 13W is low since it is not near a discernable stream channel.

- ***Direct and Indirect Effects of Action Alternative C***

  Direct and indirect effects of Action Alternative C were described in *Effects Common to Action Alternatives B and C*. No additional effects beyond those discussed would occur with this alternative.

- ***Direct and Indirect Effects of Action Alternative D***

  Action Alternative D would salvage 4 acres in Unit 6CR. Unit 6CR is located near an intermittent tributary to Cyclone Creek and would use conventional ground-based equipment. The terrain is gentle and would present a low risk of sediment delivery to the intermittent stream. Soil disturbance would be minimized through skid-trail design; constructing water bars and placing slash in skid trails would minimize the risk of sediment delivery. The remainder of the proposed salvage in Action Alternative D would be yarded with helicopters. All other impacts of Action Alternative D are described in *Effects Common to Alternatives B, C, D, and E*.

- ***Direct and Indirect Effects of Action Alternative E***

  All of the proposed salvage in Action Alternative E would be yarded with helicopters. All other impacts of Action Alternative E are described in *Effects Common to Alternatives B, C, D, and E.*

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A***

  No-Action Alternative A would have no additional cumulative effects on water yield. Existing harvest units outside of the burned area and those that survived within the burned area would continue to revegetate and move closer to premanagement levels of water use and snowpack distribution. Burned areas from the Moose Fire will be subject to conditions described in *EXISTING CONDITIONS* and will recover as dictated by natural and preexisting conditions. Hydrologic recovery in previously managed stands that were burned is lost; these stands will begin to revegetate from a nonforested condition.

  Cumulative effects of No-Action Alternative A on water quality would be similar to the situations described in the existing conditions. In-channel adjustment to water yield increases will occur because of the Moose Fire. Sediment delivery from adjacent uplands will increase, especially in areas with moderate- to high-burn severity. Risk of mass soil movement and debris flows will be increased because of the fire and may add large amounts of sediment to Coal Creek and its tributaries.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E***

  The proposed salvage harvesting in Action Alternatives B, C, D, and E is not expected to cause additional increases in surface runoff, overall water yield, or magnitude or duration of peak flows over those levels of increase already expected due to the effects of the wildfire. Only dead trees would be removed during the proposed harvesting. The harvest of dead trees is expected to have very little, if any, influence on the water balance of the affected watersheds. The dead trees are no longer capable of removing water from the soil through the evapotranspiration process and they are not providing a substantial canopy for snow or rainfall interception.

- ***Cumulative Effects Common to Action Alternatives B and C***

  The proposed ground-based and cable yarding proposed in Action Alternatives B and C would increase the risk of cumulative impacts to sediment delivery through further disturbance of burned soil. Skid trails and cable yarding corridors may concentrate overland flow and lead to channeling of water. This risk would be minimized through skid-trail design and placement of water bars and slash in trails to provide erosion control (*McIver 2000*). According to a study completed by *Chou (1994)*, no changes in sedimentation were found after post-fire logging when compared to control watersheds. Provided skid-trail spacing, equipment-restriction zones, and soil-moisture limits are all kept within the recommended levels, risk of cumulative erosion and sediment delivery are not expected to increase substantially as a result of ground-based skidding or cable yarding.

  Approximately 3.4 miles of new temporary low-standard road would be constructed with Action Alternatives B and C. These roads would involve minimal cut and fill, be located well away from streams, and portions would be

reclaimed after use. Reclamation would include partial recontouring, construction of water bars, installation of slash, and grass seeding. These roads would meet current BMP standards, and have low risk of increasing cumulative sediment delivery. None of the roads would be constructed on steep sideslopes or located on sensitive soil types prone to mass movement. All other cumulative impacts to water quality would be similar to those discussed under *EXISTING CONDITIONS* and *DIRECT AND INDIRECT EFFECTS*.

- ***Cumulative Effects Common to Action Alternatives D and E***

  The proposed salvage activities in Action Alternatives D and E are not expected to increase sediment yields substantially. Proposed Unit 6CR (4 acres) is the only unit proposed for ground-based harvesting (Action Alternative D only) in either of these alternatives. The terrain in Unit 6CR is gentle and would present a low risk of sediment delivery to the intermittent stream. Soil disturbance in Unit 6CR would be minimized through skid-trail design; constructing water bars and placing slash in skid trails would minimize risk of sediment delivery. The remainder of the proposed salvage would be yarded with helicopters, and, thus, would not disturb the soil beyond the effects of the Moose fire. In addition, submerchantable trees, limbs, and tops would be left on site with helicopter yarding, which would provide additional erosion control on all slopes, reducing potential sediment delivery.

Appendix D

Fisheries Analysis

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

APPENDIX D
FISHERIES

INTRODUCTION

The Coal Creek drainage supports a native salmonid population of bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Bull trout are Federally listed as "threatened" under the Endangered Species Act and westslope cutthroat trout are considered a "Class A Species of Special Concern" through a joint listing developed by DFWP and the Montana Chapter of the Amercian Fisheries Society. Class A species are those that are limited in numbers and/or limited in habitat both in Montana and elsewhere in North America; elimination from Montana would be a significant loss to the gene pool of the species. Both species in Coal Creek have been genetically tested and have been identified as pure strains. Native mountain whitefish (*Prosopium williamsoni*) and sculpin (*Cottus spp.*) also inhabit the waters of the Coal Creek drainage.

The U.S. Fish and Wildlife Service (USFWS) is in the process of drafting a Recovery Plan for Bull Trout, in addition to drafting a report designating critical habitat for the species. The State of Montana has developed a *Restoration Plan for Bull Trout in the Clark Fork and Kootenai Basins (DFWP, 2000).*

The bull trout and westslope cutthroat trout population of the Coal Creek drainage support 3 possible life-history patterns that can occupy vast geographic areas.

Resident - resides and reproduces in natal stream.

Fluvial - outmigrates to the North Fork of the Flathead River or the main stem of the Flathead River as

TABLE D-1 - BULL TROUT AND WESTSLOPE CUTTHROAT TROUT PRESENCE(X) AND ABSENCE IN WATERBODIES OF THE COAL CREEK DRAINAGE NEAR THE PROPOSED HARVEST UNITS

STREAM	SPECIES	
	BULL TROUT	WESTSLOPE CUTTHROAT TROUT
Coal	X	X
Cyclone	X	X
Dead Horse		X
Unnamed tributary to Coal Creek (Section 36)		X
Cyclone Lake	X	X

TABLE OF CONTENTS

Introduction 1
Analysis Methods 2
Analysis Area 3
Existing Conditions 3
Description of Alternatives 14
Description of SMZ… 15
Alternative Effects 16

juvenile to sexually mature and returns to natal stream to spawn.

Adfluvial - outmigrates to Flathead Lake as juvenile to sexually mature and returns to natal stream to spawn.

According to the *Montana Bull Trout Scientific Group (1998)*, migratory bull trout can move great distances (up to 250 kilometers) among lakes, rivers, and tributary streams in response to spawning, rearing, and adult habitat needs. *Fraley and Shepard (1989)* estimated that about half the adult bull trout from Flathead Lake embark on this spawning migration each year to reach tributaries of the North and Middle Forks of the Flathead River.

Recent genetic research has yielded important information about bull trout populations. *Kanda and Allendorf (2001)* indicated that the large population differentiation within drainages that they detected suggests that little gene flow has occurred among bull trout populations even over short geographic distances and that geographically close populations have been highly isolated reproductively. Parallel to this, some of the genetic differentiation among populations may have evolved through adaptation to local environments *(Fox 1993; Phillipp and Clauson 1995; in Kanda and Allendorf, 2001)*. In addition, available data indicate that, at times, year classes of bull trout may be produced from a small number of spawners (Kanda, 1998).

ANALYSIS METHODS

The methodology used to assess existing conditions includes the evaluation of trout populations and their physical habitat. Physical habitat is broken into 4 main headings: sediment, woody debris, stream temperature, and fish passage. These are analyzed for each action alternative. Potential impacts as a result of a particular action alternative would be evaluated through ongoing monitoring of fish populations, including redd counts, habitat-quality monitoring, and identification of risk factors to habitat degradation.

POPULATIONS

Fish populations have been sampled in the Coal Creek drainage by DFWP through electroshocking. One-pass presence/absence and relative abundance efforts have been completed to provide cursory information about fish populations. Three-pass depletion estimates, or mark-recapture techniques, have been employed to obtain population estimates.

PHYSICAL HABITAT

Sediment

Fine sediment in the analysis area has been evaluated by substrate scores and/or McNeil coring. A substrate score is an ocular assessment of streambed particle

TABLE D-2 - GENERAL TIMEFRAME OF LIFE HISTORY CHARACTERISTICS OF BULL TROUT AND WESTSLOPE CUTTHROAT TROUT IN THE COAL CREEK DRAINAGE

	SPECIES	
	BULL TROUT	**WESTSLOPE CUTTHROAT TROUT**
Spawning	September through early October	Late April through May
Egg incubation	September through January	May through June
Fry emergence	April through May	June through July
Rearing time (age of fish at outmigration)	1+ juveniles	Young of year and 1+ juveniles
Migrational spawing movement	July through August	March through April

size and the relative degree of embeddedness. Embeddedness refers to the degree of amouring, or the tight association of substrate. A higher substrate score indicates more favorable fisheries habitat conditions. Low substrate scores indicate smaller streambed particles and greater embeddedness, which constitutes poorer quality fish habitat. A stream is considered threatened if the substrate score is less than 10. McNeil coring is a method used to determine the size range of material in streambed spawning sites. Results are given as a percentage of material less than 6.35 millimeters and indicate the quality of spawning and incubation habitat. The smaller the percentage of fine materials, the better the habitat condition. If the percentage is 35 percent, the stream is considered threatened; red-flag "critical" values are assigned to values over 40 percent.

Woody Debris

Woody debris in the Coal Creek drainage has been described by 2 studies: *Hauer, Gangemi and Baxter (1997)* and the *USFS R1/R4 (1995)* methodology. In the study by *Hauer, Gangemi and Baxter (1997)*, Coal Creek was 1 of 8 streams with reaches analyzed in third- and fourth-order segments as known bull trout tributaries. Two stream reaches on Coal Creek, 100 meters in length, were analyzed for large woody debris that was more than 10 centimeters in diameter and 1 meter in length. The *USFS R1/R4* technique classifies large woody debris pieces as those active pieces within the wetted width and those inactive pieces that are in the stream channel and are an influence at high flows. Qualifying pieces are at least 3 meters or two-thirds the wetted width in length. Pieces are at least 15 centimeters in diameter, two-thirds of the length from the base.

ANALYSIS AREA

Coal Creek is a 52,469-acre watershed and the main drainage of Coal Creek State Forest, which is located north of Columbia Falls, Montana. In addition to Coal Creek, the Moose Fire Salvage and Reforestation Project - Phase II analysis area includes 2 major tributaries (Dead Horse and Cyclone creeks) to the Coal Creek watershed. Due to perennial flow and fish presence, all of these streams are considered Class I streams.

EXISTING CONDITIONS

MOOSE FIRE INFLUENCE

According to *Deleray (2001)*, DFWP completed postfire surveys on September 6, 2001 to assess the impacts of the Moose Fire. They completed 1 survey each on Coal and Cyclone creeks and at each site found no dead fish, only live westslope cutthroat trout and sculpin. Dead Horse Creek was surveyed at a later date with mixed results indicating a (unknown) level of fish kill in short reaches of the creek. According to the *Moose Fire BAER Report (2001)*, bull trout representing a variety of age classes were observed in spawning, rearing, and migratory areas and tributaries to Coal Creek, while a portion of the critical spawning habitat was located within the fire perimeter.

However, most of the primary spawning areas are located upstream of any proposed harvest unit in the Moose Fire Salvage and Reforestation Project - Phase II analysis area. Important bull trout spawning areas include portions of the upper reaches of Coal, the North Fork of Coal, the South Fork of Coal, and Mathias creeks and their tributaries.

- **Coal Creek**

  Coal Creek is considered a core area for bull trout. Core areas are drainages that historically

and currently contain the strongest populations of bull trout and are important for spawning, rearing, and adult habitat needs. These habitats are key to the continued existence of bull trout in the Flathead Basin *(Montana Bull Trout Scientific Group, 1995)*.

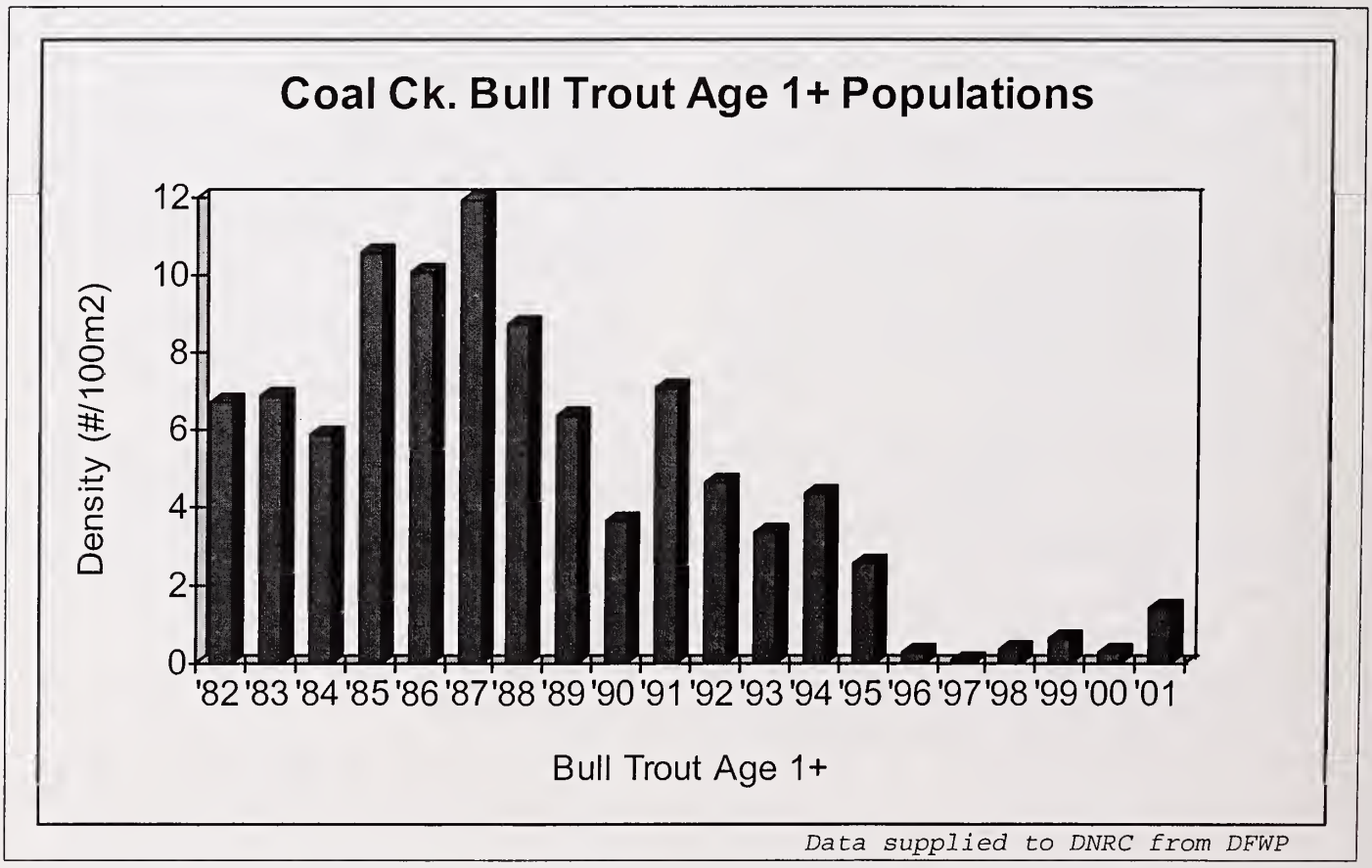
Populations

Bull trout population data from 1982 through 2001 and redd-count trend data from 1981 through 2000 are represented in *FIGURE D-1 – SUMMARY OF ANNUAL BULL TROUT AGE 1 AND OLDER POPULATIONS IN COAL CREEK, 1982 THROUGH 2001 (DEAD HORSE REACH, 150-METER SECTION)* and *FIGURE D-2 –BULL TROUT REDD-COUNT TREND DATA ON COAL CREEK, 1981 THROUGH 2001*. Whereas, westslope cutthroat trout population data exists from 1982 through 2000, valid estimates were only obtained for 3 years. The highest population estimate for westslope cutthroat trout was in 1983 with a value of 56 fish, plus or minus 15 fish (number per 100 square meters). Since 1990, not enough fish have been caught (12 or greater) to obtain estimates. Redd counts for westslope cutthroat trout are difficult to obtain due to high spring-flow conditions during and/or after spawning.

Annually, since 1981, bull trout redd-count surveys have been conducted in Coal Creek from the junction of the South and North Forks of Coal Creek downstream to the confluence of Dead Horse Creek. The highest density of redds occur on State and USFS land above the area affected by the Moose Fire.

Historically, the Coal Creek drainage supported about 10 percent of the Flathead Basin bull

FIGURE D-1 - SUMMARY OF ANNUAL BULL TROUT AGE 1 AND OLDER POPULATIONS IN COAL CREEK, 1982-2001 (DEAD HORSE REACH, 150-METER SECTION).



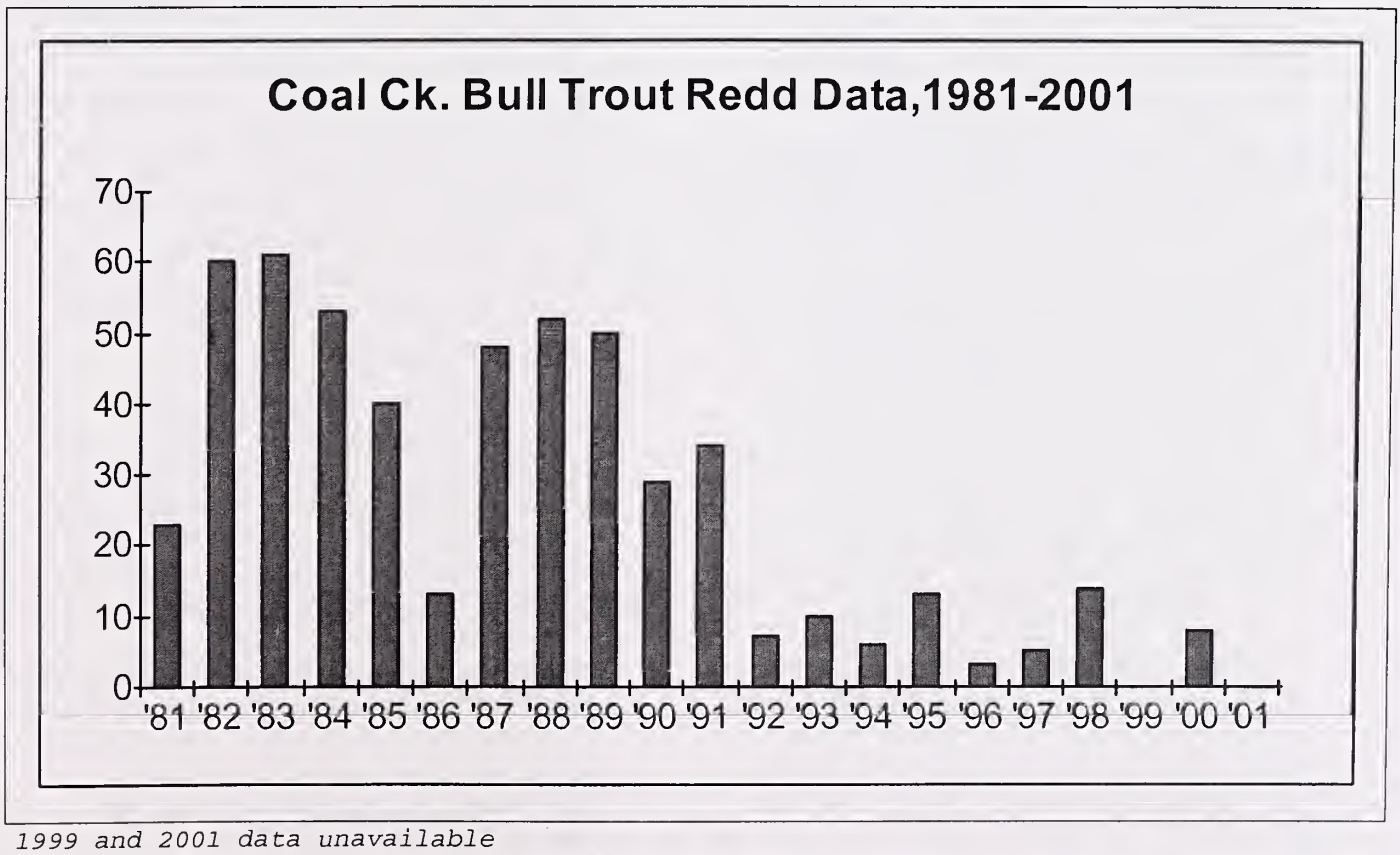
Data supplied to DNRC from DFWP

trout redds and has declined to under 2 percent in 2000 *(Moose Fire BAER Report, 2001)*. The goal of bull trout restoration efforts for the migratory population in the Flathead River drainage, according to the *Montana Bull Trout Scientific Group (1995)*, is to maintain or restore self-sustaining populations in the core areas, protect the integrity of the population genetic structure, and enhance the migratory component of the population. Specifically, the goals are to increase bull trout spawners to attain the average redd count level of the 1980s and maintain this level for 15 years (3 generations) in the North Fork and Middle Fork monitoring areas; provide long-term stable or increasing trend in overall populations; and provide for spawning in all core areas.

Why the bull trout population levels depicted in *FIGURE D-1 - SUMMARY OF ANNUAL BULL TROUT AGE 1 AND OLDER POPULATIONS IN COAL CREEK, 1982-2001 (DEAD HORSE REACH, 150-METER SECTION)* and the bull trout redd numbers represented in *FIGURE D-2 - BULL TROUT REDD-COUNT-TREND DATA ON COAL CREEK, 1981 THROUGH 2001* have declined in recent years is unclear. The best explanation could be that these downward trends are represented by a variety of reasons.

One of these reasons does include the effects of timber harvesting. According to the *Montana Bull Trout Scientific Group (1995)*, past forestry practices (road construction, log skidding, riparian tree harvesting, clearcutting, splash dams) were often damaging to watershed

FIGURE D-2 - BULL TROUT REDD-COUNT-TREND DATA ON COAL CREEK, 1981 THROUGH 2001



1999 and 2001 data unavailable
Data from Montana Bull Trout Scientific Group (1995), DNRC (1998), and data submitted to DNRC from DFWP

conditions and are a major contributing cause of the decline of bull trout. The effects of these practices on habitat include increased sediment in streams, increased peak flows, hydrograph and thermal modifications, loss of in-stream woody debris and channel stability, and increased access to anglers and poachers.

However, cumulative impacts from other human-caused sources within the Flathead Basin must also be assessed to better understand the population dynamics of bull trout and westslope cutthroat trout in the Coal Creek drainage. This is due to the far-reaching migratory behavior of bull trout and, to a lesser extent, westslope cutthroat trout. Some issues raised by the *Montana Bull Trout Restoration Team (1998)* in analyzing the relationship between land-management activities and the habitat requirements of bull trout in the Flathead Basin include: residential and industrial development, mining, livestock grazing, agriculture, irrigation diversions, dams, secondary roads, recreation, transportation systems, fire management, and the introduction of nonnative species, including *Mysis* shrimp in Flathead Lake.

According to *Weaver (1997)*, a significant decline in redd numbers in the Flathead Basin occurred during the early 1990s due to the alteration of the trophic dynamics in Flathead Lake. Since 1992, the number of bull trout redds has remained relatively stable (6 years), but this level is approximately 70 percent below the average during the preceding 12-year period (1980 through 1991). Specifically, bull trout redds in Coal Creek have been reduced by 82 percent after the introduction of *Mysis relicta* shrimp in Flathead Lake. A period of record for 12 years prior to *Mysis* introduction showed an average of 41.4 redds/year compared to 7.3 redds/year for a 6-year period after *Mysis* introduction *(Weaver, 1997)*.

However, *M. Deleray (personal communication)* indicates that Coal Creek has suffered declines greater than those of other streams in response to the *Mysis* introduction. Using the 2000 index redd count in 8 streams, Coal Creek had only 7 percent as many bull trout redds as it did in the 1980 through 1990 period, while the other 7 streams averaged 81 percent as many redds as they had in the same period. It appears other factors in the Coal Creek drainage have decreased bull trout abundance beyond what is observed in other streams of the Flathead drainage.

In addition to the *Mysis* introduction, the lake trout (*Salvelinus namaycush*) introduction to Flathead Lake has influenced bull trout population densities in Flathead Lake through direct competition of resources and lake trout predation on juvenile bull trout. According to *Weaver (1997)*, the mechanisms causing the decline are not completely clear and considerable uncertainty remains about bull trout ecology and trophic interactions in Flathead Lake.

Physical Habitat

In 1978, DFWP began its *Coal Creek/Flathead River Basin Monitoring Study* to develop baseline data for the Flathead River Basin and its tributaries. One of the tributaries sampled through this effort is Coal Creek. In order to meet the recommendations for bull trout and westslope cutthroat trout from the *Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program (Flathead Basin Commission, 1991)*, DNRC has contracted with DFWP for the

TABLE D-3 - IN-STREAM PHYSICAL HABITAT CHARACTERISTICS OF COAL CREEK

REACH	RIVER MILES	GRADIENT	POOL RATIO	RUN RATIO	RIFFLE RATIO	POCKET RATIO
Mouth to Dead Horse Creek	0.0-5.9	1.2	4%	50%	40%	6%
Dead Horse Creek to South Fork of Coal Creek	5.9-10.0	1.0	10%	60%	20%	10%
Data obtained from Montana Rivers Information System website						

collection efforts required to develop index values of existing habitat quality as recommended *(DNRC, 1998)*.

DNRC considers the values of the general habitat conditions found in *TABLE D-3 – INSTREAM PHYSICAL HABITAT CHARACTERISTICS OF COAL CREEK* to be compatible to the life history needs of bull trout and westslope cutthroat trout and these values are comparable to other streams in the surrounding area that contain these species.

According to the *Montana Bull Trout Restoration Team (2000)*, bull trout have very strict habitat requirements that are generally referred to as the four C's - clear, cold, complex, and connected. This includes clean, cold water; high levels of shade, undercut banks, and woody debris in streams; and connectivity among and between drainages. Bull trout also seem to prefer areas of gaining groundwater or groundwater up-welling reaches. The *Montana Bull Trout Scientific Group (1998)* states that the majority of migratory bull trout spawning in Montana occurs in a small percentage of the total stream habitat available. Spawning adults use low-gradient areas (less than 2 percent) of gravel/ cobble substrate. Proximity to cover for the adult fish (such as pool habitat with overhead protection) before and during spawning is an important habitat component. Actual redd construction often occurs in pool tail-out crests or low-gradient riffles. Juvenile fish utilize pocket pool habitat and the interstitial spaces within the substrate for rearing cover often in close association with large woody debris.

- ***Sediment***

  According to the *Montana Bull Trout Scientific Group (1998)*, a substantial inverse relationship exists between the percentage of fine sediment in the incubation environment and bull trout survival to emergence. *Deleray et al (1999)* states that redds become less suitable for incubating embryos if fine sediments and organic materials are deposited in interstitial spaces of the gravel during the incubation period. Fine particles impede movement of water through the gravel, thereby reducing delivery of dissolved oxygen to, and flushing of, metabolic wastes away from incubating embryos. *Weaver and Fraley (1991)* reported a significant negative correlation between brook trout embryo survival and later fry emergence and sediment fine content (less than 2.0 millimeter) in tributaries of the Flathead River.

  Heede et al (1988; in Rinne 1990) states that human-induced watershed disturbances, like natural disturbances (e.g. wildfires, intense meteorological events), may increase the input of fine sediment beyond the capability of the stream to effectively discharge through transport by flushing flows. If extensive enough, ensuing substrate fines buildup may reduce substrate

interstices to a degree that negatively influences fish reproduction *(Hall and Lantz 1969; in Rinne 1990)* and food supply *(Bjornn et al. 1977; Alexander and Hansen, 1986; in Rinne 1990)*.

Salvage timber harvesting and associated activities may exacerbate fine sediment input from the fire without proper planning and mitigation. According to *Rieman and Clayton (1997)* disturbance by fire, harvesting activities, and road construction invariably results in greater erosion and sediment production; however, the severity and longevity of increase is highly dependent on site properties and the kind of disturbance. Road construction causes the most severe disturbance to soils on slopes, far overshadowing fire and logging as a cause of accelerated erosion *(Swanson and Dyrness 1975; Beschta 1978; Reid and Dunne 1984 in Rieman and Clayton, 1997)*. *Eaglin and Hubert (1993)* found that trout standing stocks had a negative relation with the density of culverts and that erosion of soil from road surfaces, ditches, and disturbed areas adjacent to roads that subsequently is deposited in stream channels seems to be an important mechanism by which logging has affected stream habitat.

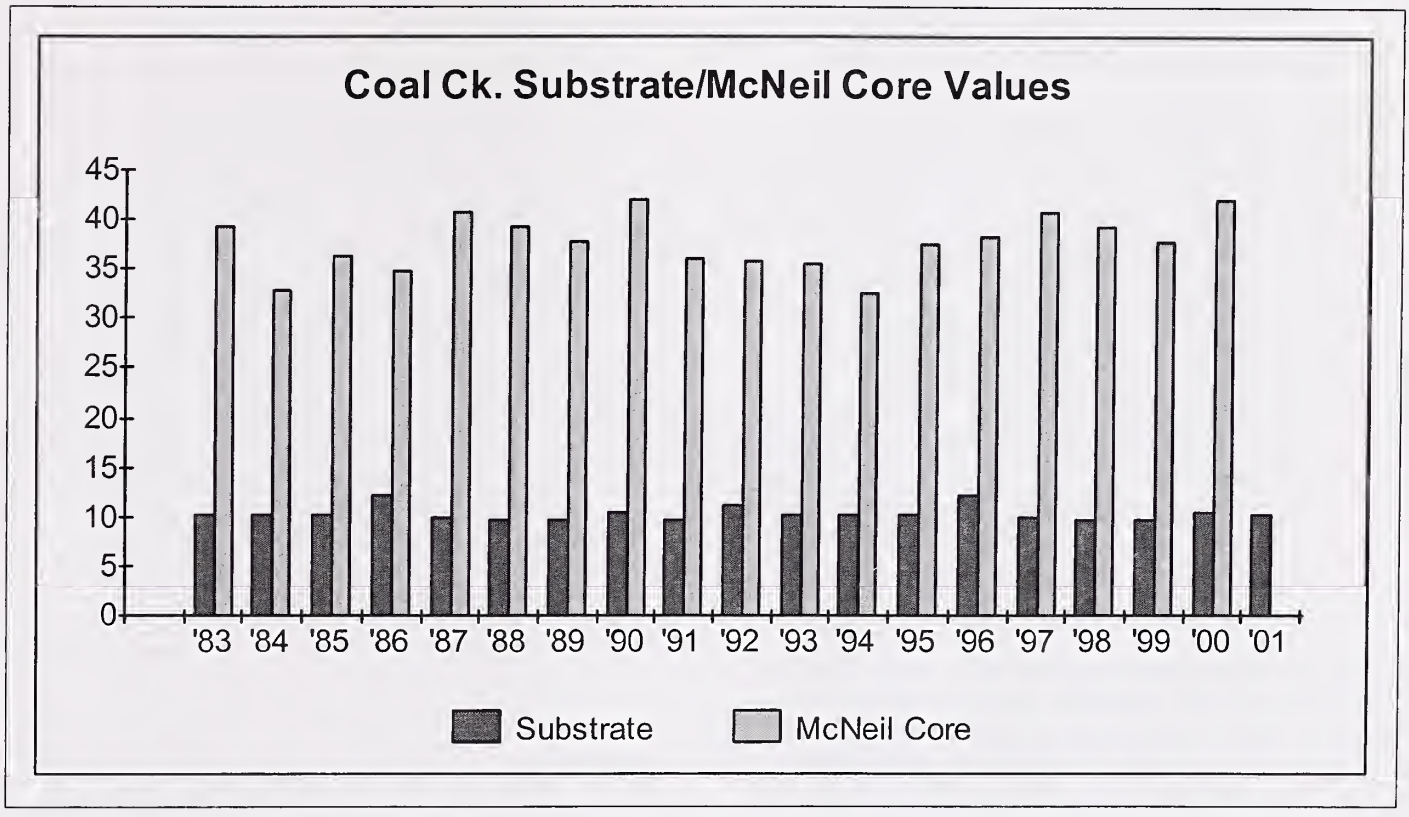
An additional vehicle for sediment input to the waters of the Coal Creek drainage comes from potential mass-wasting events that lead to debris flows. The Moose Fire has most likely enhanced this possibility in the Coal Creek drainage. *Rieman and Clayton (1997)* indicate that wildfires may trigger major debris flows, floods, and erosion that can harm or even destroy small fish populations and other aquatic biota. According to the *Moose Fire BAER Report (2001)*, flow increases from the fire may also be joined by debris flows of the floatable and transportable material within the channel areas. Recent experiences at both Sierra Grande and the East Fork Bitterroot fires clearly show how flow and debris are interrelated. The highest postfire debris flows at both of these areas were a combination of water and debris, called bulking, in which jams formed and broke, causing surges or slugs of material down the channels.

According to the *Moose Fire BAER Report (2001)*, the east flank of Winona Ridge and Section 2 on the south side of Coal Creek have deeply incised perennial and ephemeral stream bottoms that burned with high or moderate burn severity where the natural revegetation/ reestablishment of shrubs and trees are going to be significantly reduced for several years. This makes these draws susceptible to erosion and debris torrents with the right type of storm and/or snowmelt event.

Since 1983, DFWP has collected Substrate Scores and McNeil Cores to analyze fine sediment loading in the Coal Creek drainage. The *Flathead Basin Commission (1991) Cooperative Study Report* recommended caution when the amount of fine material (6.35 millimeter or smaller), as indicated by McNeil coring, exceeded 35 percent. Recommendations call for a 'red flag' at levels above 40 percent *(DNRC, 1998)*.

Bull trout and westslope cutthroat trout spawning and incubation habitat has been adversely affected by high

FIGURE D-3 - COAL CREEK SUBSTRATE SCORES AND MCNEIL CORE VALUES, 1983 THROUGH 2001



McNeil values for 2001 unavailable
Data from DNRC (1998) and data supplied to DNRC by DFWP

levels of sediment deposition. McNeil core trend data from 1983 through 2000, as represented for Coal Creek in *FIGURE D-3—COAL CREEK SUBSTRATE SCORES AND MCNEIL CORE VALUES, 1983 THROUGH 2001*, indicate that out of the 18 years with data, 4 years had "critical" values above 40 percent and 11 years had "threatened" values from 35 to 40 percent. Substrate values indicate 5 years had a "threatened" value of less than 10 from this same time period.

Past land-use activities coupled with the natural geology of the Coal Creek drainage have probably combined to produce McNeil fine sediment values at or near critical levels. In addition, an increase in sediment delivery from increased runoff from the Moose fire to the streams of the Coal Creek drainage is expected. This sediment delivery to the stream in subsequent years would be reduced as vegetation is restored. Sediment liberated by human-related activities occurred before the advent of BMPs and SMZs.

Fine sediment can also be liberated to stream channels through mass wasting and debris flows. However, fire-related debris flows and floods usually occur only in limited areas, such as from dry, south- or southwest-facing steep slopes that are slower to revegetate.

- ***Woody debris***

Woody debris is an essential component in forming pools and overhead cover for fish while diversifying channel dimensions. The factors that directly affect introduction, stability, or character of stream large woody debris have a potentially

significant influence on native fish populations that utilize streams for spawning, rearing, or growth and completion of life histories *(Andrus et al. 1988; in Hauer, Gangemi and Baxter, 1997)*. *(Hauer, Gangemi and Baxter, 1997)* state from their study of large woody debris in the Flathead Basin that the implications for forest managers are twofold: 1) that with harvest comes increased unpredictability in the frequency of size, attachment, and stability of the large woody debris, and 2) riparian zones without harvest may be essential to long-term maintenance of natural stream morphology and habitat features.

The *Hauer, Gangemi and Baxter (1997)* woody debris evaluation results are summarized in *TABLE D-4 - WOODY DEBRIS FREQUENCY IN COAL CREEK; TABLE D-5 - WOODY DEBRIS DIAMETER CLASS AND ASSOCIATION WITH BANKS IN COAL CREEK; AND TABLE D-6 - DECAY CLASS OF LARGE WOODY DEBRIS IN COAL CREEK.*

DNRC considers that the values represented in *TABLES D-4 THOUGH D-6* indicate good woody debris volumes, including good values regarding the associations with attachment and relation to the banks. DNRC considers the represented data to meet or exceed the woody debris life-history needs of bull trout and westslope cutthroat trout; these values are comparable or exceed those values of other streams in the surrounding area that contain these species.

- ***Stream Temperature***

Temperature data in Coal Creek collected by FNF show the maximum stream temperature as 14.5 degrees centigrade between 1984 and 1995 and this is considered acceptable for sustaining a cold-water fishery.

TABLE D-4 - WOODY-DEBRIS FREQUENCY IN COAL CREEK

REACH	FREQUENCY (NUMBER)	VOLUME (m3)	ATTACHED	UNATTACHED	WITHOUT ROOTWAD	WITH ROOTWAD
A	123	119.0	57	66	119	4
B	36	51.0	19	17	34	2

From Hauer, Gangemi and Baxter, 1997

TABLE D-5 - WOODY-DEBRIS DIAMETER CLASS AND ASSOCIATION WITH BANKS IN COAL CREEK

REACH	NO CONTACT WITH BANKS BY DIAMETER CLASS				CONTACTING ONE BANK BY DIAMETER CLASS				CONTACTING BOTH BANKS BY DIAMETER CLASS			
	1	2	3	4	1	2	3	4	1	2	3	4
A	44	24	5	4	16	17	4	6	0	2	1	0
B	9	4	3	1	8	3	2	5	0	1	0	0

Diameter classes: 1 = 10 to 20 centimeters, 2 = 20 to 30 centimeters, 3 = 30 to 40 centimeters, 4 = 40 to 50 centimeters

From Hauer, Gangemi, and Baxter, 1997

TABLE D-6 - DECAY CLASS OF LARGE WOODY DEBRIS IN COAL CREEK

REACH	WITH BARK AND LIMBS BY DIAMETER CLASS				SURFACE ROTTED BY DIAMETER CLASS				EXTENSIVELY ROTTED BY DIAMETER CLASS			
	1	2	3	4	1	2	3	4	1	2	3	4
A	13	13	2	2	45	28	6	8	2	2	2	0
B	5	1	0	1	12	7	5	5	0	0	0	0

Diameter classes: 1 = 10 to 20 centimeters, 2 = 20 to 30 centimeters, 3 = 30 to 40 centimeters, 4 = 40 to 50 centimeters

From Hauer, Gangemi, and Baxter, 1997

Increases in mean maximum summer temperatures are likely in the waters of the Coal Creek drainage as a result of the Moose Fire. Solar radiation to streams will be increased from the loss of canopy cover; this situation will exist until streamside vegetation is reestablished in burn-affected areas.

Fraley and Shepard (1989) indicate that juvenile bull trout are very rare in streams with a maximum summer water temperature exceeding 15 degrees centigrade, and that adult migratory bull trout entered the tributaries when water temperatures dropped below 12 degrees centigrade, and spawned from late August through early October after temperatures dropped below 9 degrees centigrade. The best survival of embryos is a temperature of around 4 degrees centigrade *(Kanda, 1998)*. Increases in water temperatures could have a detrimental effect on egg development and rearing success for both bull trout and westslope cutthroat trout.

A healthy riparian area provides stream shade needed to keep stream temperatures cool.

If riparian vegetation is destroyed, the effects include increased summer and decreased winter water temperatures resulting from removal of shading and insulating vegetation; reduced large woody debris recruitment caused by removal of source vegetation; reduced pool quality, habitat complexity, channel stability, and bank stability arising from removal of vegetation and bank erosion; and reduced substrate quality by sediment delivery *(Montana Bull Trout Scientific Group, 1998)*.

- ***Fish passage***

  No barriers to fish passage exists in Coal Creek, and no impediments to fish migration exist between Coal Creek and Flathead Lake. According to the *Montana Bull Trout Scientific Group (1995)*, the South Fork of the Flathead, lower Flathead, and Swan rivers contain barriers, which have cut off portions of the watersheds; the remaining upper Flathead (North Fork and Middle Fork) is one of the last drainages that still has good interconnectedness between spawning and rearing habitat for migratory fish.

- **Cyclone Creek**

  Populations

  The Cyclone Creek drainage is an 8,353-acre watershed tributary, including Cyclone Lake (145 acres in surface area), to Coal Creek and supports a disjunct population of bull trout. According to the *Montana Bull Trout Scientific Group (1995)*, disjunct populations are defined as those in headwaters lakes that appear to be self-reproducing and functionally isolated from the Flathead Lake system. This is due to stream intermittency during low flows, coupled with stream temperatures at the upper threshold preference for bull trout, in the area between the outlet of the lake and the confluence with Coal Creek.

  For Cyclone Creek, redd counts have been conducted since 1994 and periodic data exists in approximately the first 1 kilometer downstream of the Cyclone Lake outlet *(TABLE D-8 – BULL TOUT REDD-COUNT-TREND DATA ON CYCLONE CREEK, 1994 THROUGH 2000)*. According to *Weaver (1998)*, inlet tributaries to Cyclone Lake are small and flows are extremely low during late summer, so spawning here is

TABLE D-8 – BULL TROUT REDD-COUNT TREND DATA ON CYCLONE CREEK, 1994 THROUGH 2000

STREAM	YEAR						
	1994	1995	1996	1997	1998	1999	2000
Cyclone	5	5	5	0	0	0	0
Data from Montana Bull Trout Scientific Group (1995), DNRC (1998), Weaver (1997), and data submitted to DNRC from DFWP.							

TABLE D-9 – WESTSLOPE CUTTHROAT TROUT REDD-COUNT TREND DATA ON CYCLONE CREEK, 1996 THROUGH 2001

STREAM	YEAR					
	1996	1997	1998	1999	2000	2001
Cyclone	Fry present	31	Fry present	16	19	24
Data supplied to DNRC by DFWP						

TABLE D-10 – CYCLONE CREEK SUBSTRATE SCORES AND MCNEIL CORE VALUES, 1995 THROUGH 2000

	YEAR						
	1995	1996	1997	1998	1999	2000	2001
Substrate	11.1	11.3	11.6	11.4	11.9	11.4	11.6
McNeil Core	--	33.1	33.8	32.6	36.4	35.2	NA
Data from DNRC (1998) and data supplied to DNRC by DFWP							

unlikely, although age 0+ bull trout are present. In Cyclone Creek, the *Moose Fire BAER Team (2001)* indicated that a short section of the lower spawning reach was within the fire boundary. Cyclone Creek bull trout redd data exists for 1994 through 2000 and can be found in *(TABLE D-8 – BULL TOUT REDD-COUNT-TREND DATA ON CYCLONE CREEK, 1994 THROUGH 2000)* and westslope cutthroat trout redd count data from 1996 through 2001 can be found in *TABLE D-9 – WESTSLOPE CUTTHROAT TROUT REDD COUNT TREND DATA ON CYCLONE CREEK, 1996 THROUGH 2001.*

Why there has been a decline in the number of bull trout redds on Cyclone Creek in recent years is unclear. As a disjunct population, other basinwide activities, such as those discussed earlier for the Coal Creek bull trout population, probably have less of an influence on the Cyclone Creek population. However, a continued population and redd count monitoring effort in this location, which will increase the validity of the trend data, should provide further explanation on the matter.

Data represented in *TABLE D-9 – WESTSLOPE CUTTHROAT TROUT REDD COUNT TREND DATA ON CYCLONE CREEK, 1996 THROUGH 2001* indicate that westslope cutthroat trout redd-count production and fry-recruitment levels are relatively stable.

Physical Habitat

DFWP began collecting Cyclone Creek data in 1995 as a component of the *Flathead Basin Monitoring Study*.

- ***Sediment***

  Data with values from 5 years on Cyclone Creek indicate that 2 McNeil values fell within 35 to 40 percent, with the remainder below 35 percent. No

substrate scores were at values below 10, indicating favorable substrate conditions (*TABLE D-10 – CYCLONE CREEK SUBSTRATE SCORES AND MCNEIL CORE VALUES, 1995 THROUGH 2000*).

- ***Woody debris***

  No in-channel woody-debris data exists for the Cyclone Creek drainage. The riparian area received low to moderate burn severity during the Moose Fire. Qualitatively, DNRC considers woody debris to be relatively abundant as compared to other streams of the surrounding area.

- ***Stream temperature***

  Stream temperatures are known to be at the upper threshold preference for bull trout in the area between the outlet of Cyclone Lake and the confluence with Coal Creek, which is one of the reasons for classifying the bull trout population in this drainage as disjunct.

- ***Fish passage***

  The bull trout population in Cyclone Lake is considered disjunct as a result of being functionally isolated from the rest of the Flathead Lake basin. This isolation is due to stream intermittency during low flows, coupled with stream temperatures at the upper threshold preference for bull trout in the area between the outlet of Cyclone Lake and the confluence with Coal Creek. Field surveys during the Moose Fire indicated that Cyclone Creek was dry from the confluence with Coal Creek, upstream to approximately 200 yards below Cyclone Park.

- **Dead Horse Creek**

  Dead Horse Creek is a 6,588-acre tributary to Coal Creek. Less than 1,000 acres of this watershed is managed by the State of Montana.

  Populations

  Little population data exists for Dead Horse Creek, other than it contains a high westslope cutthroat trout population and sculpins. This stream is not considered a bull trout stream by DFWP, although incidental occurrences of bull trout are found *(Weaver, personal communication)*.

  Postfire, sections of Dead Horse Creek were shocked with mixed results, indicating an (unknown) level of fish kill in short reaches of the creek; however, a large fish kill was not reported *(Weaver, personal communication)*.

  Physical Habitat

  - ***Sediment***

    No in-stream fine-sediment data exists for Dead Horse Creek. According to the *Moose Fire BAER Report (2001)*, Dead Horse Creek was either severely burned or soils are unstable and some mass movement is expected. However, the Moose Fire BAER Team thought that there would not be significant impacts to Dead Horse Creek because:

    * the riparian vegetation is sprouting;
    * large amounts of dead fall are on the slopes;
    * slopes were below 45%; and
    * the creek drains into a large swamp prior to reaching Coal Creek, thus filtering sediment.

  - ***Woody debris***

    No existing in-channel data exists for woody debris volumes for Dead Horse Creek on State

land; however, FNF inventoried Dead Horse Creek above the State land boundary and found woody-debris numbers ranging from 23 to 29 pieces of debris per 100 meters of stream. DNRC considers these values to be good to excellent for the life-history needs of bull trout and westslope cutthroat trout. Dead Horse Creek did experience a high-intensity burn in the riparian corridor during the Moose Fire.

- ***Stream temperature***

  No stream-temperature data exists for Dead Horse Creek. However, the maximum temperature found in Coal Creek would suggest that this feeder tributary would have temperatures at or below those of Coal Creek. A result of the high-intensity burn in the Dead Horse Creek riparian corridor during the Moose Fire will likely result in an increase in solar radiation and, thus, temperature until the reestablishment of vegetation.

- ***Fish passage***

  No fish passage barriers exist in Dead Horse Creek.

DESCRIPTION OF ALTERNATIVES

- ***Description of No-Action Alternative A***

  No-Action Alternative A would not salvage-harvest timber. Watershed restoration and mitigation activities would proceed according to the *Moose Fire BAER Report (2001)*, as would DNRC-identified fire-restoration and road-maintenance interventions designed to mitigate effects from recent fire-suppression activities. Without mitigation, the fire-suppression activities could negatively affect bull trout and westslope cutthroat trout habitat by exacerbating natural tendencies (i.e. fine-sediment delivery) of the landscape response to the fire.

- ***Description of Action Alternative B***

  Action Alternative B would include the following activities:

  - Ground-based yarding of 681 acres (57 percent), downhill-cable yarding of 90 acres (7 percent), and helicopter yarding of 430 acres (36 percent) would comprise the harvest.
  - Harvesting would include stands defined as old growth.
  - Temporary roads (3.4 miles) would be built and reclaimed.
  - 2.8 miles of existing road would be reconstructed.
  - Approximately 8,883 thousand board feet (MBF) of timber would be harvested.
  - Portable steel bridges would be installed over Cyclone and Dead Horse creeks and an unnamed tributary to Cyclone Creek and be removed at the completion of harvesting activities.
  - Douglas-fir bark-beetle-killed trees located north of the fire perimeter on the west side of Winona Ridge would be helicopter logged.

- ***Description of Action Alternative C***

  Action Alternative C is essentially the same as Action Alternative B, except for the following activities:

  - 1.25 miles of existing road would be reconstructed.
  - No old-growth stands would be harvested, including the stand of Douglas-fir beetle-killed trees.
  - Ground-based yarding of 677 acres (74 percent), downhill-cable yarding of 78 acres (9 percent), and helicopter yarding of 158 acres (17 percent) would comprise the harvest.
  - Approximately 4,820 MBF of timber would be harvested.

- ***Description of Action Alternative D***

  Action Alternative D would include the following activities:

  - 1.5 miles of existing road would be reconstructed.
  - Harvesting would include stands defined as old growth.
  - Helicopter logging of 849 acres (99.5 percent); no temporary roads, except for the possibility of short spur roads to land that is adjacent to existing roads.
  - Ground-based yarding of 4 acres (0.5 percent).
  - Approximately 8,454 MBF of timber would be harvested.
  - Douglas-fir bark-beetle-killed trees located north of the fire perimeter on the west side of Winona Ridge would be helicopter logged.

- ***Description of Action Alternative E***

  Action Alternative E is essentially the same as Action Alternative D, except for the following activities:

  - Old-growth stands, including the stand of beetle-killed trees, would not be harvested.
  - Approximately 4,391 MBF of timber would be harvested entirely by helicopter.

DESCRIPTION OF SMZ AND TEMPORARY ROAD MITIGATION COMMON TO ACTION ALTERNATIVES B, C, D, AND E

Under Action Alternatives B, C, D and E, the SMZ delineated on all fish-bearing streams would include a 100-foot no-harvest zone in addition to a 25-foot equipment exclusion.

Temporary roads would be located and built to the minimal standards necessary to prevent impacts to water quality and provide a safe and efficient route to remove logs from the salvage timber sale area. Following logging operations, reclamation would incorporate concepts to discourage future motorized use of the roads. Segments near the beginning of the new temporary road systems would be reshaped to their natural contours and reclaimed for approximately 200 feet by grass seeding and strewing slash and debris. The reclamation of the remaining road would include a combination of ripping or mechanically loosening the surface soils on the road, removing culverts or bridges that were installed, spreading forest debris along portions of the road, and allowing the surface to revegetate naturally. In addition, the timing of the proposed activities would follow guidelines set forth by DFWP through the 124 Permit process.

Prior studies demonstrate that SMZs minimize damage to habitat and effectively maintain the integrity of fish populations. This evidence is generally consistent over a wide span of time and space. In a study of how logging activities affect the wintertime stream environment for salmonoids, *Heifetz et al. (1986)* found that buffer strips protected winter habitat of juvenile salmonoids by maintaining pool area and cover within pools. In some cases, blowdown from buffer strips added large organic debris to the stream and increased the cover within pools. In addition, timber harvesting from streamside areas can increase incident solar radiation and decrease the large woody debris supply that reduces protection from peak flows and decreases hydraulic complexity.

Meehan (1991) expands on the importance of streamside management as a tool to protect fishery values through demonstrated studies that have compared fish habitat and salmonoid populations in streams that were and were not given riparian protection during timber harvests.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A***

Populations

No-Action Alternative A would have no direct effects on fish populations of the Coal Creek watershed. Direct effects would be limited to those under current and natural conditions allowing bull trout and westslope cutthroat trout populations to recover naturally from the effects of the Moose Fire.

Physical Habitat

- ***Sediment***

No-Action Alternative A would not influence the natural landscape process of sediment delivery to stream channels in the Coal Creek drainage as a result of the Moose Fire.

- ***Woody Debris***

With no harvest of the recruitable woody debris, No-Action Alternative A would not influence the natural landscapes processes associated with in-stream or recruitable woody debris activity as a result of the Moose Fire.

- ***Stream Temperature***

As indicated under *EXISTING CONDITIONS* of this report, stream temperatures are expected to increase through the loss of canopy cover and increased solar radiation as a result of the Moose Fire. No-Action Alternative A would not influence the natural recovery of riparian vegetation and subsequent stream shading.

- ***Fish Passage***

Currently, the only barrier to fish migration in the Coal Creek drainage is in Cyclone Creek during low flows, as described under *EXISTING CONDITIONS*. No-Action Alternative A would not influence the natural landscapes processes from those of the Moose Fire.

- ***Direct Effects Common to Action Alternative B and C***

Populations

No direct effect to trout populations would occur under Action Alternatives B and C.

Direct effects from limiting factors associated with the physical channel environment are considered under the *Physical Habitat* section, below.

Physical Habitat

- ***Sediment***

The creation of 3.4 miles of temporary roads would involve the placement of culverts and the construction of temporary bridges over Cyclone and Dead Horse creeks and the unnamed tributary in Section 36. These actions, including the rehabilitation and stabilization of these sites, could result in some sediment entering these streams. This turbidity, if not mitigated as previously noted, could become excessive enough to cause acute mortality to fish species and/or incubating eggs through suffocation. In addition, high levels of turbidity could displace fish to other areas of the stream, stressing individual fish and disrupting natural behavior. However, under Action Alternatives B and C, any fine sediment introduction is expected to be mitigated from these activities through erosion control methods, the 124 Permit process, and BMPs.

- ***Woody Debris***

No large woody debris in the first 100 feet of fish-bearing streams would be harvested under any action alternative, based on

the inclusion of DNRC mitigated SMZs. As a result, most of the large woody debris that is likely to provide for future recruitment would be retained and no direct effect to fish populations would exist.

- ***Stream Temperature***

  Action Alternatives B and C incorporate previously described SMZs. As a result, no influence to the existing quality of riparian vegetation or streamside shading would occur that would increase stream temperatures.

- ***Fish Passage***

  Under Action Alternatives B and C, the temporary bridge crossings on Cyclone and Dead Horse creeks and the unnamed tributary in Section 36 that follow BMPs and 124 Permit guidelines would not affect fish passage.

- ***Direct Effects of Action Alternatives D and E***

Populations

Action Alternatives D and E would have no direct effect on fish populations of the Coal Creek watershed as a result of SMZs, with all harvesting activities located away from fish-bearing streams.

Physical Habitat

- ***Sediment***

  Action Alternatives D and E only include the construction of short, temporary spur roads and do not include the installation of stream crossings. Through DNRC-mitigated SMZs, all proposed harvest units are located far enough from fish-bearing streams that no direct effect to fish health would occur from the liberation of fine sediment.

- ***Woody Debris***

  No large woody debris in the first 100 feet of fish-bearing streams would be harvested under any action alternative, based on the inclusion of DNRC mitigated SMZs. As a result, most of the large woody debris that is likely to provide for future recruitment will be retained and no direct effect to fish populations would exist.

- ***Stream Temperature***

  Action Alternatives B and C incorporate the previously described SMZs. As a result, no influence to the existing quality of riparian vegetation or streamside shading would occur that would increase stream temperatures.

- ***Fish Passage***

  As a result of Action Alternatives D and E only involving temporary short spur roads and no installation of stream crossings, no direct effect to fish passage would occur.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A***

Populations

Indirect effects of No-Action Alternative A would be limited to those expected to occur under current conditions and those conditions resulting from the Moose Fire.

Physical Habitat

- ***Sediment***

  Under No-Action Alternative A, indirect fine-sediment delivery to streams would be limited to those under current conditions and those expected to result in the future as a result of the Moose Fire. In addition, this alternative would not alter postfire natural events

associated with mass wasting and debris flows.

- ***Woody Debris***

  With no harvest of the recruitable woody debris, No-Action Alternative A would not influence the natural landscape processes associated with in-stream or recruitable woody debris activity as a result of the Moose Fire.

- ***Stream Temperature***

  No-Action Alternative A would not influence the natural recovery of riparian vegetation as a result of the Moose Fire.

- ***Fish Passage***

  No temporary road building or the installation of stream crossings would occur under No-Action Alternative A. Therefore, no indirect effect to fish passage would occur. In addition, according to the *Moose Fire BAER Report (2001)*, under a categorical exclusion document, annual flights by a fisheries biologist will take place after spring run-off to analyze the potential for woody-debris migratory barriers and stream-channel transitions that could negatively effect stream health. Mitigation measures can then be implemented prior to the movement of migratory bull trout.

- ***Indirect Effects Common to Action Alternatives B and C***

  Populations

  Indirect effects to fish populations could occur from specific physical habitat-limiting factors (see below) under Action Alternatives B and C.

  Physical Habitat

  According to the *Montana Bull Trout Scientific Group (1998)*, the indirect effects of upland timber management on bull trout and their habitat may include reduced pool quality, habitat complexity, channel stability, and bank stability caused by increased peak flows (See *APPENDIX D—HYDROLOGY* for peak-flow evaluation).

  - ***Sediment***

    As stated under the *EXISTING CONDITIONS* section of this report, road building and harvesting activities could increase the delivery of sediment to stream channels under the right conditions. Potential indirect sediment sources under Action Alternatives B and C could result from the construction of 3.4 miles of temporary roads, including the installation of culverts and the construction and removal of 3 temporary bridges on Cyclone and Dead Horse creeks and unknown tributary in Section 36. In addition, a salvage timber harvest employing ground-based yarding and downhill-cable techniques could indirectly effect sediment delivery to the stream channel.

    However, with the temporary nature of roads to be constructed for salvage-harvesting operations in addition to the reclamation of these areas, the indirect effects of Action Alternatives B and C would be reduced as compared to roads left in place after harvesting activities. If either Action Alternative B or C were implemented, indirect fine-sediment delivery to the stream channel would be substantially reduced as a result of SMZs and salvage harvest mitigation measures. Specifically, these include:

    * project timing,
    * incorporation of expanded SMZs,
    * BMPs,

* location of harvest units predominately away from stream channels,
* areas of discontinuous channels,
* revegetation potential,
* slope angles of the proposed harvest units,
* road and culvert mitigation measures, and
* postfire restoration mitigation measures.

- ***Woody Debris***

  With the inclusion of DNRC-mitigated SMZs, Coal Creek, as a *Rosgen (1995)* "C" channel type, would retain its ability to laterally migrate within its floodplain and still acquire large woody debris for channel stability and in-stream habitat complexity. Cyclone Creek and Dead Horse Creek are predominately *Rosgen (1995)* "B" channel types that are more confined with less lateral stream migration.

  Under Action Alternatives B and C, incorporation of the DNRC-designed SMZs would allow any burn-affected riparian area to recover naturally. This would continue to provide floodplain integrity against natural channel migration and streamside shade and overhead cover for trout. In addition, this would buffer the potential for fluctuating stream temperatures and sediment delivery to stream channels. In addition, the location of harvest units predominately outside flood-prone areas would minimize the detrimental effects to in-stream woody-debris recruitment.

- ***Stream Temperature***

  Alteration of natural streamflow regimes as a result of road building under Action Alternatives B and C could increase water temperatures and reduce groundwater inflows needed to keep summer maximum stream temperatures down. However, Action Alternatives B and C incorporate the previously described SMZs, and temporary roads will be reclaimed after harvesting operations are completed. As a result, the negative influence to stream temperatures is considered low.

- ***Fish Passage***

  As a result of the mitigated SMZs, the harvest units located primarily outside flood-prone areas, and the proposed mitigation-monitoring activity described in Action Alternative A, Action Alternatives B and C would not likely result in detrimental effects to fish passage in the Coal Creek drainage and not affect migratory connectedness with other waters needed for bull trout and westslope cutthroat trout to complete life-history patterns.

- ***Indirect Effects Common to Action Alternatives D and E***

  Populations

  Indirect effects to fish populations could occur from specific physical habitat-limiting factors (see below) under Action Alternatives D and E.

  Physical Habitat

  - ***Sediment***

    Since Alternatives D and E utilize helicopter logging, those issues concerning sediment delivery to stream channels through the construction of temporary roads and associated road crossings, yarding, and downhill-cable techniques need not be considered.

  - ***Woody Debris***

    The potential indirect effects under Action Actions D and E are

the same as those listed under Action Alternatives B and C.

- ***Stream Temperature***

  The potential indirect effects under Action Actions D and E are the same as those listed under Action Alternatives B and C.

- ***Fish Passage***

  The potential indirect effects under Action Actions D and E are the same as those listed under Action Alternatives B and C.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A***

Populations

Under No-Action Alternative A, bull trout and westslope cutthroat trout are expected to recover naturally. As stated in the *EXISTING CONDITIONS* section of this analysis, no postfire fish kills were observed in Coal or Cyclone Creek. The postfire assessment by DFWP of Dead Horse Creek showed a mixed level of fish kill in short reaches of that stream. Fires are natural landscape events that bull trout and westslope cutthroat trout have adapted to, as evidenced by complex life-history patterns. As a result, No-Action Alternative A is not expected to influence the cumulative effects of natural landscapes processes from the Moose Fire and the other natural and/or human-caused factors associated with trout populations.

Physical Habitat

- ***Sediment***

  Fine-sediment accumulation is expected to naturally increase in the waters of the Coal Creek drainage during rain events and snowmelt runoff as a result of the Moose Fire. Fire-suppression activities during the Moose Fire have also had an impact on fine-sediment delivery to the stream channel. Road blading, opening closed segments of roads, and dozer-line construction delivered some increased sediments into bull trout habitat *(Moose Fire BAER Report, 2001)*. However, No-Action Alternative A would not influence the cumulative natural-landscapes processes from the Moose Fire in addition to past and future land use activities as they relate to sediment input to stream channels.

- ***Woody Debris***

  Recruitment levels of woody debris for the next 1 to 5 years are expected to be high in burn-affected-riparian and flood-prone areas. In many of these areas, the roots and bases of many trees were either burned or seriously weakened by the fire, making them susceptible to windthrow. *Rieman and Clayton (1997)* state that soil strength declines as roots decay and typically reaches a minimum in 5 to 10 years after disturbance, but buttressing by large trees may last for several decades after mortality.

  In addition to past and future land-use activities related to in-stream and recruitable woody debris issues, No-Action Alternative A would not influence the cumulative natural-landscape processes above the Moose Fire. Recruitable woody debris would be left standing to be incorporated into the stream as natural events dictate.

- ***Stream Temperature***

  In addition to past and future land-use activities related to stream temperature issues, No-Action Alternative A would not influence the cumulative natural-landscape processes from the Moose Fire.

- ***Fish Passage***

  With a potential for an increased unpredictability in the frequency of size, attachment, and stability of large woody debris comes an increased risk of large debris jams accumulating in Coal Creek that could potentially impede or altogether block upstream migration of trout. However, a woody debris jam that would completely block upstream fish movement, without the inclusion of other material from a debris-torrent event would be considered unusual.

  No-Action Alternative A would not influence the cumulative natural-landscape processes from the Moose Fire in addition to past and future land use activities related to fish passage issues.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E***

  Populations

  No additional cumulative effects to those previously identified under Action Alternative A are expected from the implementation of Action Alternatives B, C, D, and E on trout populations. Indirect cumulative limiting factors associated with the physical channel environment are considered under the *Physical Habitat* section, below. In addition, native trout populations in the Flathead Basin, including those in the Coal Creek drainage, would undergo continued land use pressure effects from human-caused factors.

  Physical Habitat

  - ***Sediment***

    Under Action Alternatives B, C, D and E, harvesting activities would not substantially impact the cumulative amount of fine-sediment delivery to the stream channel as a result of harvesting operations and would be substantially reduced as a result of SMZs and salvage-harvest mitigation measures. Specifically, these include:

    * project timing,
    * incorporation of expanded SMZs,
    * BMPs,
    * location of harvest units predominately away from stream channels,
    * areas of discontinuous channels,
    * revegetation potential,
    * slope angles of proposed harvest units,
    * road and culvert mitigation measures, if applicable, and
    * postfire restoration mitigation measures.

  - ***Woody Debris***

    As a result of the DNRC-designed SMZs and the harvest units located predominately outside flood-prone areas, no detrimental cumulative effects to in-stream woody debris or recruitable woody debris within the flood-prone area would likely result from implementation of Action Alternative B, C, D or E.

  - ***Stream Temperatures***

    Alteration of natural streamflow regimes as a result of road building under Action Alternatives B, C, D, and E, if applicable, could increase the cumulative effect to water temperatures and reduce groundwater inflows needed to keep summer maximum stream temperatures down. However, Action Alternatives B and C incorporate previously described SMZs, and temporary roads will be reclaimed after harvesting operations are completed. As a result, the negative cumulative influence to stream temperatures

is considered low.

- ***Fish Passage***

  As a result of the DNRC-designed SMZs, harvest units located predominately outside flood-prone areas, and proposed mitigation-monitoring activity, Action Alternatives B, C, D, and E would not likely result in detrimental cumulative effects to fish passage in the Coal drainage nor affect migratory connectedness with other waters needed for bull trout and westslope cutthroat trout to complete life-history patterns.

Appendix E

Vegetation Analysis

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT PHASE II

APPENDIX E
VEGETATION ANALYSIS

INTRODUCTION

This section provides a detailed description of the conditions of the forest and addresses the potential effects of the proposed alternatives related to the following issues:

- the potential outbreaks of bark beetles from fire-weakened trees;
- a reduction of snags or the retention of too many snags within the burned area;
- the potential build-up of fire hazards from dying burned and dead trees;
- the effects to the amount, distribution, and attribute level of old growth from proposed harvesting; and
- the effects to the amount and distribution of noxious weeds occupying Coal Creek State Forest.

ANALYSIS METHOD

The effects of the Moose Fire on vegetation will be briefly described as part of the existing conditions (additional information can be located in the *Wildfires of 2001 Post-Fire Assessment, USFS 2001* and *Moose Fire Salvage and Reforestation Project EA, DNRC 2001*). A coarse-filter analysis will be done on the analysis area in reference to effects to age class, cover type and old-growth timber stands. Each alternative will analyze the effects to snags, coarse woody debris, and noxious weed occurrence and distribution. Old-growth amounts, distribution, and attribute level will be discussed. The data for the existing condition was a combination of DNRC's stand-level inventory, extensive traverses of the area, and more than 450 plots taken within the fire perimeter. The analysis will concentrate on the effects of implementing alternatives for the Phase II proposal; the effects the fire had on the area are considered part of the existing condition. Fire severity in regards to large-scale mortality in vegetation was mapped from the air during September 2001.

ANALYSIS AREA

The analysis area for the coarse-filter analysis is the contiguous Coal Creek State Forest, approximately 15,094 forested acres. Analysis of site-specific effects will be limited to areas where actions are proposed; consideration for adjacent lands will be analyzed where applicable. Some comparisons will be made with the historic data, representing the Upper Flathead Valley, that was collected in the 1930s (*climatic section 333c, Losensky 1997*). Historic amounts of old growth were considered in reference to the North Fork of the

TABLE OF CONTENTS

Introduction 1
Analysis Method 1
Analysis Area 1
Description of the Project Area .. 2
Existing Conditions 2
Effects of Alternatives 11

Flathead River Valley and Coal Creek State Forest.

DESCRIPTION OF THE PROJECT AREA

The Moose Fire burned a large portion (approximately 6,867 acres) of the southern half of Coal Creek State Forest:

- Elevations range from 3,800 feet in the Coal Creek bottoms to 5,400 near the top of Winona Ridge. Phase II proposed actions are primarily on State lands on the south and west aspects of Winona Ridge, the Dead Horse bottoms, and the lower two-thirds of the north aspect of the ridge that is west of the Dead Horse Road and south of Coal Creek.
- Topography ranges from flat to very steep (over 70 percent).
- The project area is accessed primarily from the Coal Creek, 909, and Dead Horse roads. Access is also proposed across private land in the northeast quarter of Section 35 to the southwest side of Winona Ridge.
- Adjacent lands include private and USFS ownerships.
- Prior to the Moose Fire in 2001, Coal Creek State Forest had some recent timber harvesting with the Cyclone/Coal '99 Timber Sale and, following a fire in 2000, the Cyclone Ridge Fire Salvage.

EXISTING CONDITIONS

FIRE HISTORY

Coal Creek State Forest has various timber types associated with various fire regimes; however, stand-replacement and infrequent mixed-severity fire regimes predominate. Regardless, as is the case throughout Montana, most sites have experienced a range of fire severities over time. Actual fire history data goes back to the late 1800s, but is not accompanied by severity estimates.

Prior to 2001, 1910 was the fire year that most influenced Coal Creek State Forest. In that year, 5,051 acres (33 percent) of the forest burned. Prior to the Moose Fire, a high percentage of the forest's shade-intolerant cover types resulted from those fires, with over 55 percent lodgepole pine stands and more than 40 percent western larch and Douglas-fir stands. Prior to the Moose Fire, only 15 percent of the mixed-conifer stands have developed on lands burned by the 1910 fires. The Moose Fire reburned 91 percent of the acres that were burned in the 1910 fires.

Approximately 632 acres burned along Coal Ridge in 1921; none of this acreage burned in any other year of recorded fire history. Much of the area regenerated to western larch/ Douglas-fir cover types.

The fires of 1926, which burned 540 acres, represent the fourth largest impact from fires on Coal Creek State Forest. None of the acres burned in 1926 were burned in other fire years.

Approximately 137 acres burned near Coal and Dead Horse creeks in 1933; most of those acres burned again in the 2001 fires.

Around 80 acres burned in Section 3, T34N, R21W, in 1981.

Stand-replacement-severity fires burned approximately 202 acres on Coal Ridge in 2000. The burnt trees were salvaged in 2001 and the acres are temporarily nonstocked. None of these acres were burned in the other fire years.

MOOSE FIRE OF 2001

The Moose Fire of 2001 burned about 45 percent of Coal Creek State Forest. Stand-replacement fires burned 24 percent of the forest, while mixed-severity fires burned 20 percent. Burn severity in the context of this report is used in reference to the degree of tree mortality. In the case of severe

fires (stand replacement is used in the same way), tree mortality exceeds 85 percent of all live stems. Mixed-severity fires were those with lower mortality within the burn perimeter. Some mixed-severity burns occurred at low intensity, but because of the deep duff levels, extremely dry conditions, and tree species composition (a high percentage of thin-barked, fire-susceptible species such as subalpine fir, Engelmann spruce and lodgepole pine), considerable mortality occurred. On September 30, 2001, while the fire was still active in some parts of the forest, severity was mapped from the air. Some underestimation of the extent of severe fires is expected due to the inability to ground verify every acre for bole and root damage to thin-barked species (lodgepole pine, subalpine fir, and Engelmann spruce). *FIGURE E-1—MOOSE FIRE AND SALVAGE REFORESTATION PROJECT—PHASE II FIRE SEVERITY MAP* shows burn severity of Moose Fire on vegetation.

AGE-CLASS DISTRIBUTION

DNRC's SFLMP adopted an approach to land management that emphasizes managing to maintain diversity on the landscape. The forest cover type and age-class distribution are used to examine landscape conditions. Comparisons are made with historic data to indicate how current conditions compare with the data collected from a larger geographic area at a time prior to when land management was extensively intensive.

The greatest difference between the 1930s data and current age-class

FIGURE E-1

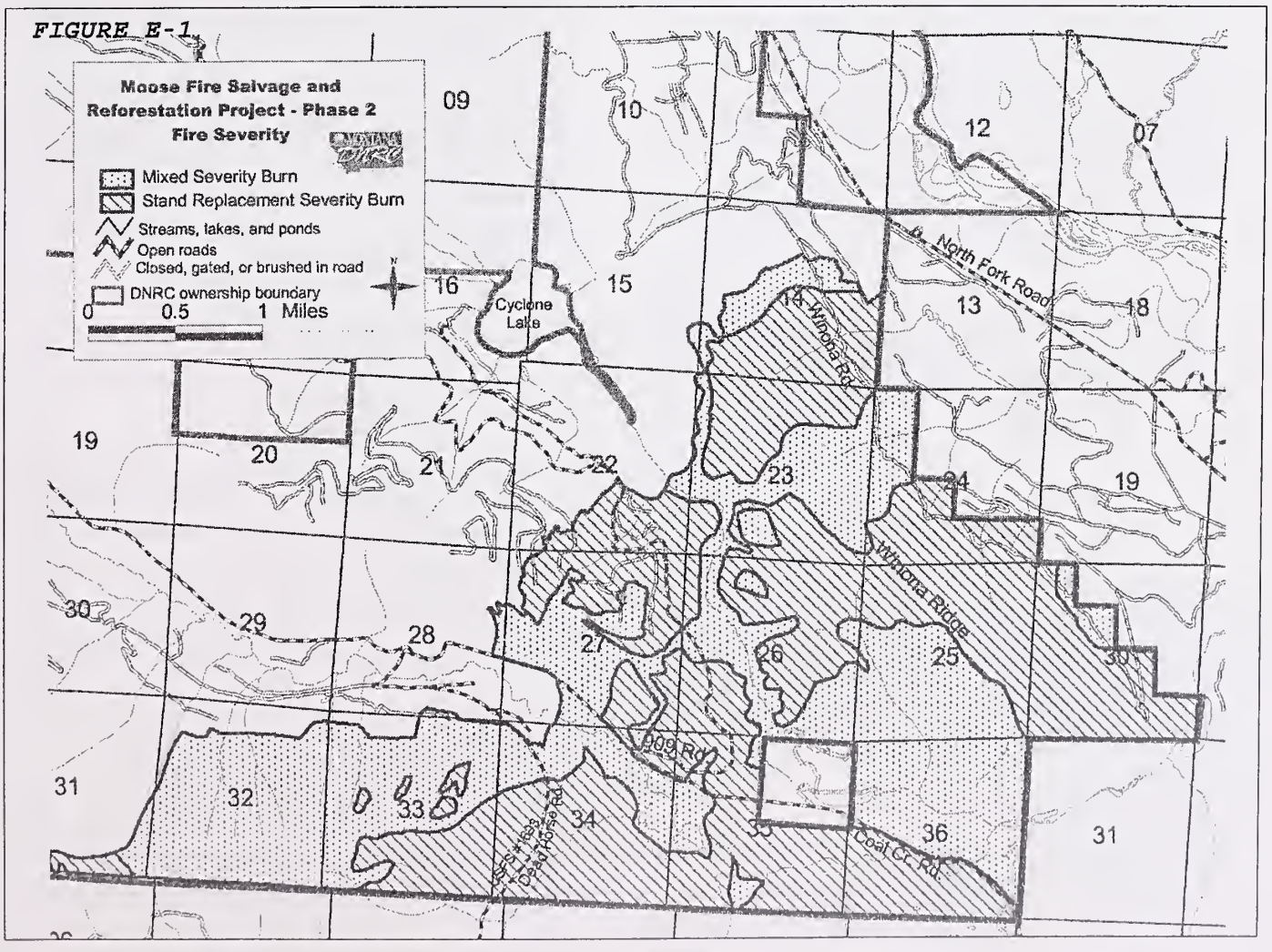
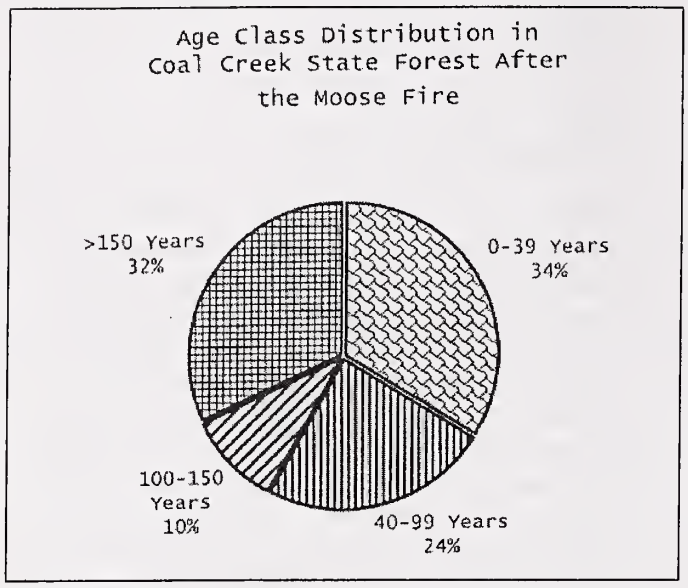
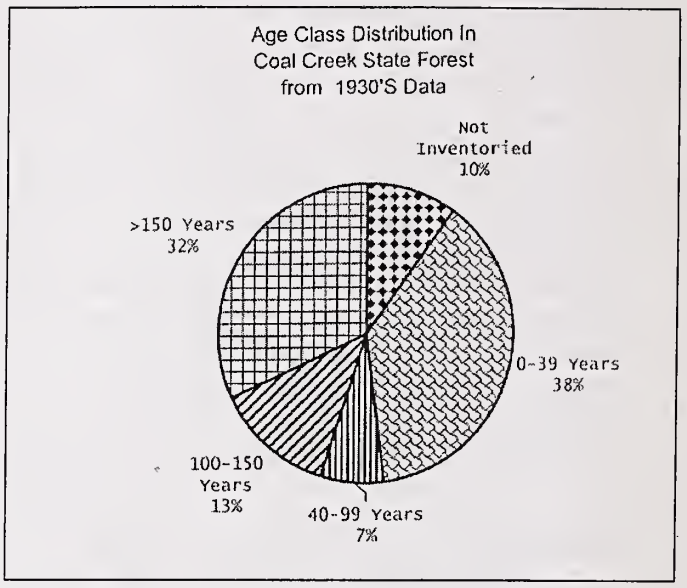


FIGURE E-2 - DISTRIBUTION OF AGE CLASSES FROM THE 1930S DATA AND THE ESTIMATED CONDITIONS THAT EXIST AFTER THE MOOSE FIRE.





distribution occurs in the 40-to-99-year age class, where current conditions are 17 percent higher. This is the case even though it is estimated that 35 percent of the area in this age class burned with severe fire intensity, which would convert the area to a younger age class. This age class was well represented on Coal Creek State Forest prior to the Moose Fire (estimated at 37 percent of the area) because of several other fires in the past 90 years.

COVER-TYPE DISTRIBUTION

For the present, the cover type of stands that burned severely in the Moose Fire are considered unchanged. As these stands regenerate, a cover type will be assigned according to the percent of species mix that occupies the site. *TABLE E-1 - COVER-TYPE REPRESENTATION BY AGE CLASS FOR COAL CREEK STATE FOREST AFTER THE FIRES OF 2001* shows the cover-type representation by age class on Coal Creek State Forest after the Moose Fire.

TABLE E-1 - COVER-TYPE REPRESENTATION BY AGE CLASS FOR COAL CREEK STATE FOREST AFTER THE FIRES OF 2001

COVER TYPE	TOTAL ACRES	AGE CLASS				
		NONE	0 TO 39 YEARS	40 TO 99 YEARS	100 TO 150 YEARS	MORE THAN 100 YEARS
Subalpine fir	3,594	0	1,022	895	718	958
Douglas-fir	1,255	0	319	237	133	566
Lodgepole pine	3,610	0	1,883	1,683	73	0
Mixed conifer	3,596	0	814	357	343	2,085
Nonforested	244	244	5	0	0	0
Nonstocked	443	368	75	0	0	0
Water	23	23	0	0	0	0
Western larch\ Douglas-fir	2,008	0	813	283	257	672
Western white pine	590	0	103	95	13	360
Totals	15,363	636	5,034	3,550	1,536	4,640

INSECT AND DISEASE CONDITIONS

Prior to the Moose Fire, insect and disease conditions were monitored in Coal Creek State Forest on a yearly basis using aerial flights; ground surveys followed in areas where high mortality was detected. Aerial flights from 1994 to 1999 indicated a 4-fold increase in acreage infested by spruce beetles and a 5-fold increase in acreage infested by Douglas-fir bark beetles on FNF *(McConnell et al 1999, McConnell et al 2000)*. Many of the burned stands had medium vigor and high stocking density. This condition increased stress on trees and can increase the occurrence of insect attacks. Prior to the Moose fire, substantial mortality occurred in Douglas-fir stands on Coal Creek State Forest, in particular, on the west aspect of the north end of Winona Ridge. This mortality was attributed to the Douglas-fir bark beetle (*Dendroctonus pseudotsuga Hopkins*). This area has also had substantial mortality attributed to Armillaria root rot (*Armillaria mellea Vahl.*). Given that the area will regenerate with relatively young vigorous trees or shrubs, the incidence of root rot is likely to decrease. The effect of fire on root disease is thought to include growth inhibition in Armillaria *(Munnecke and Darley 1976)* and a reduction in viability of rhizomorphs *(Hood and Sandberg 1989)*. Detected during the summer of 2001 prior to the Moose Fire, Douglas-fir mortality was widespread throughout Coal Creek State Forest, with substantial new attacks and red dead trees scattered along Coal Ridge. Some mortality, usually attributed to western balsam bark beetle (*Dryoctonus confuses*), was observed in the subalpine fir. Stands that had a high percentage of Engelmann spruce had small pockets of recent mortality attributed to the spruce bark beetle (*Dendroctonus rufipennis*). Some minor occurrences or recent mortality in lodgepole pine were attributed to the mountain pine beetle (*Dendroctonus ponderosa*).

Postfire conditions included large areas (approximately 3,737 acres) that were burned intensively. Trees in these areas experienced complete destruction of their cambium layer, which leaves no place for bark beetles to brood and build up populations. In contrast, approximately 3,016 acres burned with a mixed-severity intensity, which includes large areas that experienced ground fire that partially girdled tree boles and damaged crowns, but did not completely destroy the cambium layer of the trees. These trees will be extremely stressed and less able to resist bark beetle attacks. Many areas that experienced mixed-severity fires have trees that have fallen down or were felled during fire-suppression activities. These down trees experienced varying degrees of burn and, in many cases, have enough cambium to attract bark beetles to the area during the spring flight of 2002. South Coal and Winona Ridge have 2 stands (totaling approximately 340 acres) of particular concern that have either Douglas-fir and/or Engelmann spruce of the size, stocking level, and damage to be highly susceptibility to spruce beetle and Douglas-fir beetle attacks. Both stands were partially burned with mixed-severity fire intensity and are also adjacent to stands that have some of the same characteristics (dense, large-diameter Engelmann spruce or Douglas-fir) that make them susceptible to eventual beetle outbreaks. Additionally, the Winona Ridge stand has had considerable mortality the past several years from an ongoing infestation of Douglas-fir bark beetles.

SNAG NUMBERS AND CHARACTERISTICS

Snag numbers and distribution vary greatly inside area burned during the Moose Fire. Some large areas that were occupied by 40-to-99-year-old trees, predominantly lodgepole pine, were burned severely, resulting in almost complete mortality. These stands, generally, have over 300 snags per acre; however, there are few snags over 12 inches dbh. Older, mature mixed-conifer and western larch/Douglas-fir stands burned with both severe and mixed intensities. The stands that burned with stand-replacement intensity have a clumpy mosaic of snags that have remained standing. There are stringers of larger snags and small clumps or scattered individual snags that are more than 21 inches dbh. Many of the clumps and stringers of snags are associated with springs and riparian areas. The stands that experienced a mixed-severity intensity fire have snags interspersed with live trees; many of the snags are subalpine fir and Engelmann spruce because they are thin barked and less resistant to fire. Subalpine fir and Engelmann spruce snags that are, in many cases, burned out at the roots are very susceptible to windthrow. Many snags have fallen since the fire; many more are expected to fall in the near future as soils are moistened from snowmelt and rain and wind events occur.

TABLES E-2 THROUGH E-6 show the approximate distribution of live and dead trees by dbh class within the proposed harvest areas. The tables are summarized by alternative and fire severity.

COARSE WOODY DEBRIS AND FIRE HAZARD

Within the fire perimeter, a wide range of size classes and tonnage of coarse woody debris are on the ground. In some cases the fire burned through areas with such intensity that little was left on the ground; few burned snags are available or have fallen yet to contribute to the current condition, leaving less than 5 tons per acre of material greater than 3 inches in diameter. In contrast, areas exist where substantial amounts of large-diameter logs not consumed by the fire are on the ground and additional large trees have fallen during or since the fire, leaving heavy fuel loads in excess of 120 tons per acre. Within the proposed harvest area, some of the heaviest amounts of woody debris are currently located in Units 1SC and 17W.

Currently, the hazard of reburns within the fire perimeter on Coal Creek State Forest is substantially reduced from prefire conditions, because much of the fine fuels have been consumed by the fire and, in many cases, ladder fuels have burned. Over time, as dead and dying trees fall, this hazard is expected to increase. In Coal Creek State Forest, outside of the fire perimeter, there are large contiguous stands that have high-stocking densities, stand structures that include abundant ladder fuels, and substantial down fuel loadings from previous mountain pine beetle infestations and wind throw events. There are also younger stands in the 0-to-39-year age class that would burn given the right conditions, but would not build up the fire intensity of stands with very high fuel loads. These conditions are similar to the conditions of the area that was burned prior to the fire.

OLD GROWTH

Old growth for this analysis is defined as stands that meet the minimum criteria (number of trees per acre that have a minimum dbh and a minimum age) for a given site (old-growth group from habitat type). These minimums can be found in the *Green, et al, (Old Growth Forest Types of the Northern Region, R-1 SES 4/92, USDA Forest Service,*

TABLE E-2 - TREES PER ACRE IN STAND-REPLACEMENT FIRE AREAS WITHIN THE PROPOSED HARVEST AREAS OF PHASE II ACTION ALTERNATIVES B AND C

DBH	LIVE	DEAD	TOTAL
5 to 9 inches		142.4	142.4
10 to 14 inches	2.1	29.5	31.6
15 to 20 inches	0.7	8.5	9.2
21+ inches	0.3	1.8	2.1
Totals	3.1	182.0	185.1

TABLE E-3 - TREES PER ACRE IN STAND-REPLACEMENT FIRE AREAS WITHIN THE HARVEST AREAS OF PHASE II ACTION ALTERNATIVES D AND E

DBH	LIVE	DEAD	TOTAL
5 to 9 inches		45.4	45.4
10 to 14 inches	2.1	29.5	31.6
15 to 20 inches	0.7	8.5	9.2
21+ inches	0.3	1.8	2.1
Totals	3.1	85.2	88.3

TABLE E-4 – TREES PER ACRE IN MIXED-SEVERITY FIRE AREAS WITHIN THE PROPOSED HARVEST AREAS OF PHASE II ACTION ALTERNATIVES B AND C (THIS TABLE EXCLUDES THE SOUTH COAL AREA)

DBH	LIVE	DEAD	TOTAL
5 to 9 inches	4.1	107.7	111.8
10 to 14 inches	8.4	35.2	43.6
15 to 20 inches	6.2	5.8	12.0
21+ inches	1.0	1.0	2.0
Totals	19.7	149.7	169.4

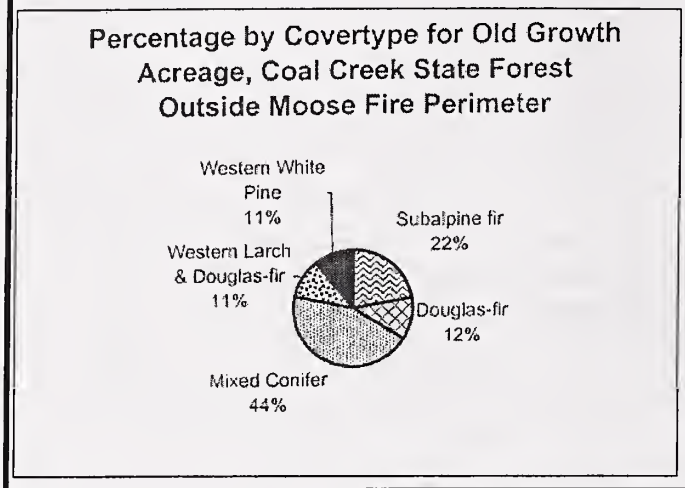
TABLE E-5 – TREES PER ACRE IN MIXED-SEVERITY FIRE AREAS WITHIN THE PROPOSED HARVEST AREAS OF PHASE II ACTION ALTERNATIVES D AND E (EXCLUDES THE SOUTH COAL AREA, Unit 1SC)

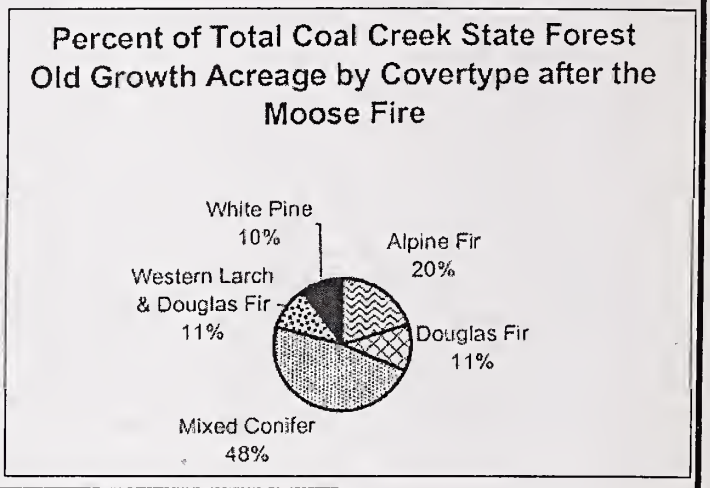
DBH	LIVE	DEAD	TOTAL
5 to 9 inches	4.1	34.7	38.7
10 to 14 inches	8.4	35.2	43.6
15 to 20 inches	6.2	5.8	12.0
21+ inches	1.0	1.0	2.0
Totals	19.7	76.7	96.4

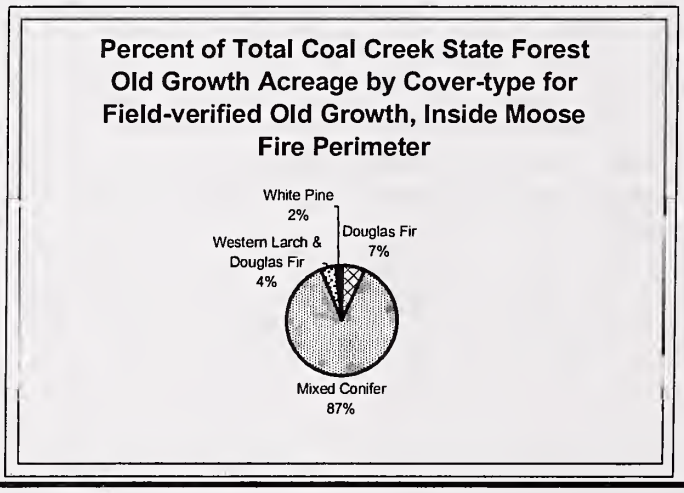
TABLE E-6 - TREES PER ACRE IN THE PROPOSED PHASE II SOUTH COAL UNIT (Unit 1SC)

DBH	LIVE	DEAD	TOTAL
5 to 9 inches	0	29	29
10 to 14 inches	2	32	34
15 to 20 inches	7	13	20
21+ inches	12	5	17
Totals	21	78	99

FIGURE E-3


Percentage by Covertype for Old Growth Acreage, Coal Creek State Forest Outside Moose Fire Perimeter
Western White Pine 11%
Subalpine fir 22%
Western Larch & Douglas-fir 11%
Douglas-fir 12%
Mixed Conifer 44%


Percent of Total Coal Creek State Forest Old Growth Acreage by Covertype after the Moose Fire
White Pine 10%
Alpine Fir 20%
Western Larch & Douglas Fir 11%
Douglas Fir 11%
Mixed Conifer 48%


Percent of Total Coal Creek State Forest Old Growth Acreage by Cover-type for Field-verified Old Growth, Inside Moose Fire Perimeter
White Pine 2%
Douglas Fir 7%
Western Larch & Douglas Fir 4%
Mixed Conifer 87%

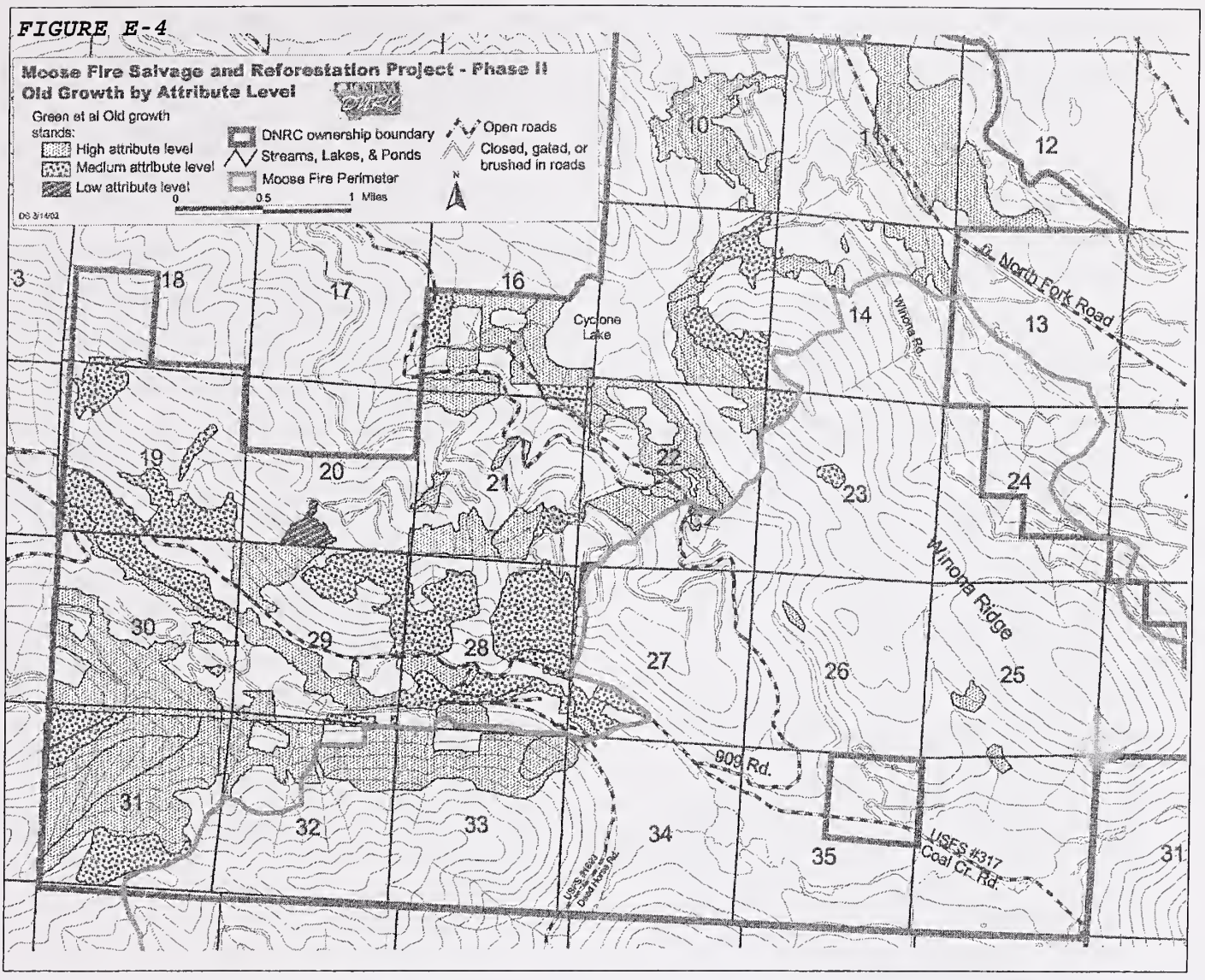
Northern Region, Missoula, MT). In the spring of 2001, the Land Board selected this method of defining old-growth stands for DNRC use. Stands that are outside the fire perimeter were identified using a stand level inventory query of conditions and, for the most part, have not been verified by field reconnaissance. Large traverses within the fire perimeter took place and data was collected; if an area had a low enough mortality rate and appeared to have a substantial amount of large live trees, fixed plots were taken to determine if the stand met the minimum criteria for old growth. If minimum criteria were met, reconnaissance was done to determine the size of the area. Using this methodology, some small areas that are not identified in this analysis could meet the minimum criteria. Areas proposed for harvesting were covered more thoroughly than those not being harvested.

TABLE E-7 – TOTAL OLD-GROWTH ACREAGE BY COVER TYPE ON COAL CREEK STATE FOREST AFTER THE MOOSE FIRE shows the approximate current distribution of old-growth stands. An approximate 24 percent of the forested acres on Coal Creek State Forest currently meet the old-growth

TABLE E-7 – TOTAL OLD-GROWTH ACREAGE BY COVER TYPE ON COAL CREEK STATE FOREST AFTER THE MOOSE FIRE

CURRENT COVER TYPE	ACRES
Subalpine fir	741.0
Douglas-fir	413.7
Mixed conifer	1,670.9
Western larch/Douglas-fir	384.1
Western white pine	364.1
Total old-growth acreage	3,573.9

FIGURE E-4



definition. *FIGURE E-4* shows the locations, distributions, and attribute levels of old-growth stands on Coal Creek State Forest following the Moose Fire.

DNRC developed a tool to assign old-growth attribute levels to stands by sorting the SLI. The attributes considered are:

- number of large live trees,
- coarse woody debris,
- number of snags,
- decadence,
- structure,
- gross volume, and
- crown density.

The sort assigns a number to a stand that indicates its total score. This provides an indication of the condition of the stand in reference to attributes that are often associated with old-growth conditions. These attribute levels are not necessarily an indication of quality, but are tools to compare and classify a collection of older stands over the landscape. The maximum value a stand could be assigned is 28. This index rating has been grouped so that values of 0 to 12 are considered as a low level of attributes, 13 to 20 a medium level, and 21 to 28 a high level. *TABLE E-8 - ACRES OF OLD GROWTH BY ATTRIBUTE LEVEL AND COVER TYPE* displays the number of acres by attribute level of stands that currently meet the old-growth definition by cover type on Coal Creek State Forest.

The Moose Fire increased the number

TABLE E-8 – ACRES OF OLD GROWTH BY ATTRIBUTE LEVEL AND COVER TYPE

COVER TYPE	ATTRIBUTE LEVEL PRIOR TO MOOSE FIRE		
	HIGH	MEDIUM	LOW
Western larch/ Douglas-fir	173.4	210.7	
Mixed conifer	1,426.2	244.6	
Western white pine	338.6	25.4	
Subalpine fir	411.4	314.3	5.4
Douglas-fir	78.8	310.7	24.3

of snags in these stands and killed much of the understory and intermediate trees in the canopy where the fire intensity was mixed severity. This change reduced overall crown density, increased down woody debris, and, in some cases, left a single-storied condition.

NOXIOUS WEEDS

Noxious weeds, primarily spotted knapweed, orange hawkweed, and several species of thistle, are found in Coal Creek State Forest. These weeds have spread mainly along open roads, adjacent to old log landings, and high-use motorized areas. Along with wind, birds, and animals, people and their management, work, and recreational vehicles have spread weed seed in the past and will continue to contribute to the spread of noxious weeds in the future.

DNRC and Flathead County Weed Department personnel have been monitoring, mapping, and treating noxious-weed infestations during their growing seasons over the past 5 years. This program, over time, should decrease noxious weed occurrences.

New introductions of noxious weeds are expected in areas burned by the Moose Fire. The removal of surface vegetation and forest litter in varying quantities will affect the quality of available seedbeds and the extent of noxious weed infestations in the future.

Also, equipment and vehicles used for fire suppression and fireline rehabilitation may have transported and deposited weed seeds near and along the existing roads, at staging areas, and in and along containment lines throughout the fire area.

Equipment and vehicles used for the BAER road reconstruction contract may have transported and deposited weed seeds near and along existing roads and near sites repaired or reconstructed as part of the BAER rehabilitation.

Equipment used for salvage logging during Phase I was cleaned prior to entering sale areas. This equipment and logging and administrative vehicles could still transport and deposit weed seeds near and along the existing roads, logging landings, and in harvest units.

TABLE E-9 – ACRES PROPOSED FOR SALVAGE HARVESTING BY ALTERNATIVE AND PERCENT OF FORESTED ACRES ENTERED INSIDE THE FIRE PERIMETER (INCLUDING PHASE I)

PHASE II ACTION ALTERNATIVE	PROPOSED ACRES ENTERED WITH SALVAGE HARVEST	% FORESTED ACRES HARVESTED WITHIN THE FIRE PERIMETER (INCLUDING PHASE I)
B	1,202	32.1
C	912	27.8
D	859	26.9
E	561	22.6

EFFECTS OF ALTERNATIVES

HARVEST PROPOSAL IN REFERENCE TO THE BURNED AREA

There are approximately 6,755 forested acres within the Moose Fire perimeter. The Moose Fire Salvage and Reforestation Project – Phase I included approximately 964 acres within its harvest units. *TABLE E-9 – ACRES PROPOSED FOR SALVAGE HARVESTING BY ALTERNATIVE AND PERCENT OF FORESTED ACRES HARVESTED INSIDE THE FIRE PERIMETER (INCLUDING PHASE I)* displays the area (acres) proposed for harvest entry by each action alternative. Also shown is the total proportion of the area in the fire perimeter entered with harvesting in both the Phase I and Phase II projects.

AGE CLASS

Direct Effects

- ***Direct Effects of No-Action Alternative A to Age Class***

  No-Action Alternative A would have no direct effects to age class.

- ***Direct Effects of Action Alternatives B, C, D, and E to Age Class***

  Age class would not be directly affected by implementing any of the action alternatives since the proposed harvesting would be limited to salvaging burnt trees that are dead or expected to die in the near future.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A on Age Class***

  Indirect effects to age class from the implementation of No-Action Alternative A would not necessarily include a change in age class, but some areas that are planted would probably become established more quickly than through natural regeneration. Since No-Action Alternative A includes no harvesting, less area would be cleared of downfall and prepared for planting, and no funds would be collected to pay for forest-improvement (FI) work. More of the burned area will likely be planted following the Phase I planting, but the area planted will most likely be limited to areas where natural regeneration was not occurring successfully within an acceptable time frame; the funding will be derived from FI collections on other timber sale projects.

- ***Indirect Effects of Action Alternatives B, C, D, and E on Age Class***

  The age class would not be indirectly affected by implementing any action alternative, but some areas that are planted would become established more quickly than through natural regeneration. It is reasonable to assume that more area would be planted with the action alternatives because more acres would be cleared of downfall and more FI funds would be

collected to accomplish this work. Since the strategy for regenerating trees includes a combination of natural regeneration and interplanting following the monitoring of success from Phase I planting, the exact area to be planted with each action alternative would be speculative. Action Alternatives B and D would harvest over the largest area and, thus, would probably plant the most area.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Age Class***

  The cumulative effects of No-Action Alternative A on age class are limited to the direct effects of planting and, thereby, establishing a stand more quickly than may occur through natural regeneration. The planting would occur in addition to the approximate 808 acres done under Phase I of the Moose Fire Salvage and Reforestation Projects; 102 acres of the Cyclone Ridge Salvage; and 185 acres of the Cyclone/Coal Timber Harvest Project.

- ***Cumulative Effects of Action Alternatives B, C, D, and E on Age Class***

  The cumulative effects of the action alternatives on age class are limited to the direct effects of planting and, thereby, establishing a stand more quickly than may occur through natural regeneration. The planting would occur in addition to the approximate 808 acres done under Phase I of the Moose Salvage; 102 acres of the Cyclone Ridge Salvage; and 185 acres of the Cyclone/Coal '99 Timber Harvest Project.

COVER TYPE

Direct Effects of Cover Type

No-Action Alternative A

- ***Direct Effects of No-Action Alternative A on Cover Type***

  No-Action Alternative A would not directly affect the cover type. The cover type, as currently defined by DNRC, is based on the percentage of species mix in a timber stand. Implementing No-Action Alternative A would not directly change this percentage.

- ***Direct Effects of Action Alternatives B, C, D, and E on Cover Type***

  None of the action alternatives would be expected to directly affect the cover types. The harvest proposals are limited to removing dead and burnt trees, which would not affect cover-type classification. Depending on the amount of trees that regenerate, some cover types would likely change regardless of the proposed actions.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A on Cover Type***

  No-Action Alternative A may indirectly affect cover types in areas where interplanting takes place and as natural plant succession occurs. Some areas that were mixed-conifer stands prior to experiencing the stand-replacement fire severity will likely regenerate as lodgepole pine stands. Lodgepole pine stands that burned will likely regenerate again as lodgepole pine cover types. The Red Bench Fire occurred north of the Moose fire in 1988 and large areas in its perimeter regenerated predominantly with lodgepole pine. The timber stand mosaic in the North Fork drainage includes many relatively even-aged stands of predominantly lodgepole pine from previous stand-replacement fires.

Interplanting that will occur with Phase I and previously planted trees will increase the species mix of western larch and western white pine in the area. This planting will likely convert stands to either western white pine or western larch/Douglas-fir cover types.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Cover Type***

  The action alternatives would indirectly affect the cover-type classification by increasing western larch and western white pine in the percent of species mix in areas where planting occurs. As these seedlings become established, some of the planted areas would likely be classified as western white pine or western larch/Douglas-fir cover types. All action alternatives would likely propose planting ponderosa pine in areas that are harvested on the south and west aspects of the Winona and Coal ridges. Depending on the success of establishing ponderosa pine over time, these areas may be classified as ponderosa pine cover types. In areas where mixed-severity fires occurred, such as harvest area 1SC, and the Douglas-fir bark-beetle salvage areas in Action Alternatives B and D, planting proposals would be limited to openings and would likely not change the cover type classification.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Cover Type***

  The cumulative effects of No-Action Alternative A on cover types would include the changes that occurred naturally from fire disturbance and the additional increase of approximately 364 acres of the harvest area that was converted to a western larch/ Douglas-fir cover type in the Cyclone/Coal '99 Timber Sale. The additional 1,010 acres planted with western larch and western white pine with the Cyclone Fire Salvage and Moose Fire Salvage and Reforestation Project—Phase I may cause cover types to be reclassified over many of these acres.

- ***Cumulative Effects of Action Alternatives B, C, D, and E on Cover Type***

  The cumulative effects of the action alternatives on cover type would include the changes that occurred naturally from fire disturbance and the additional increase of approximately 364 acres of harvest area that was converted to a western larch/ Douglas-fir cover type in the Cyclone/Coal '99 Timber Sale. The additional 1,010 acres, planted with western larch and western white pine in the Cyclone Fire Salvage and Moose Fire Salvage and Reforestation Project—Phase I, may cause cover-type reclassification over many of these acres.

INSECT AND DISEASE CONDITIONS

Direct Effects

- ***Direct Effects of No-Action Alternative A on Insect and Disease Conditions***

  The direct effects expected include the risk of large population build-ups of spruce and Douglas-fir bark beetles in the area that burned in South Coal and of Douglas-fir bark beetle build-ups in the area that burned on the west and south aspects of Winona Ridge. Conditions in these 2 areas (South Coal and Winona Ridge) within the Moose Fire area suggest a high likelihood of beetle population build-ups. Presently, populations of Douglas-fir beetles are high in many parts of western Montana, including tributaries of the North Fork of the Flathead River. Aerial survey data collected in 2001 prior to the fire showed numerous groups of beetle-killed Douglas-fir trees.

While the fire may have killed some developing beetles, many probably survived, and the adjacent areas still have unusually high populations. These outbreaks, very dependent upon warm and dry conditions that weaken their hosts and increase the chance for beetle survival, will continue as long as susceptible hosts and favorable weather conditions persist. Development of bark beetle outbreaks in stands with conditions of this type is well documented *(FHP 2000)*.

Fires that appear to have caused the least damage frequently burned on wetter sites, often in areas dominated by Engelmann spruce. While fire damage may appear to be light, relatively minor burning around the base may be all that is required to damage thin-barked Engelmann spruce sufficiently to make them susceptible to a spruce beetle infestation. Outbreaks of this type are also not unprecedented, as evidenced in the Little Wolf Fire on the Tally Lake Ranger District, FNF *(Gibson, Lieser and Ping 1999)*.

- ***Direct Effects of Action Alternatives B, C, D, and E on Insect and Disease Conditions***

  Direct effects of the action alternatives on insect and disease infestation would be a reduction of fire-weakened trees that are potential hosts to bark beetles, which would reduce the potential for infestations to occur. Action Alternatives B and D would harvest fire-weakened Douglas-fir and Engelmann spruce in South Coal and on Winona Ridge and propose an optional harvest of Douglas-fir trees that are infested with bark beetles over approximately 109 acres north of the fire perimeter on Winona Ridge. Action Alternatives C and E would not include harvesting in South Coal or the area north of the fire perimeter on Winona Ridge.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A on Insect and Disease Conditions***

  Indirect effects of No-Action Alternative A would include a high risk of mortality from bark beetle attacks on mature stands that are located adjacent to burned stands in South Coal and on Winona Ridge. Because beetle survival is much higher in weakened trees, the potential build-up in burned stands would threaten the adjacent stands that have characteristics such as large-diameter host trees and stocking densities greater than 150 square feet of basal area per acre. While mortality in trees already damaged by fire may be slight, the greater threat is to nearby adjacent undamaged stands of large-diameter Engelmann spruce. In fact, adjacent tributaries of the North Fork of the Flathead River, including Coal Creek State Forest, were sites of the last major spruce beetle outbreak during the early 1980s. Species that are proposed for planting in the fire-burned area (western larch, western white pine and ponderosa pine) are not primary hosts of Douglas-fir or spruce bark beetles.

- ***Indirect Effects of Action Alternatives B, C, D, and E on Insect and Disease Conditions***

  The indirect effects of the action alternatives would be a reduction in the risk of high amounts of bark-beetle mortality to mature timber stands located near burned stands. Action Alternatives B and D would harvest fire-weakened trees in the South Coal area where conditions of adjacent stands could facilitate large build-ups of beetle populations. Action Alternatives C and D propose no harvesting in South Coal, thus, the risk for beetle population build-ups would remain the same in that area. Under Action Alternatives B and D, proposed

harvesting of beetle-attacked trees north of the fire perimeter on Winona Ridge could, over the long term, reduce the ongoing mortality from Douglas-fir bark-beetle attacks.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Insect and Disease Conditions***

  Cumulative effects of No-Action Alternative A are additions to the risk of bark beetle infestations from areas that burned, but were not treated, with the Moose Fire Salvage and Reforestation Project—Phase I. That project, the Cyclone Ridge Fire Salvage, and Cyclone/Coal '99 Timber Harvest Project were designed, in part, to reduce the risk of bark-beetle mortality in Coal Creek State Forest.

- ***Cumulative Effects of Action Alternatives B, C, D, and E on Insect and Disease Conditions***

  Cumulative effects of the action alternatives are reductions to the risk of bark-beetle infestations from surrounding areas that burned, but were not treated with Moose Fire Salvage and Reforestation Project—Phase I. The proposed Phase II salvage, Cyclone Ridge Fire Salvage, and Cyclone/Coal '99 Timber Harvest Project were designed, in part, to reduce the risk of mortality from bark beetles.

SNAG AMOUNTS AND DISTRIBUTION

Direct Effects

- ***Direct Effects of No-Action Alternative A on Snag Amounts and Distribution***

  There would be no direct effects on the amount and distribution of snags from the current condition with No-Action Alternative A.

- ***Direct Effects of Action Alternatives B, C, D, and E on Snag Amounts and Distribution***

  The direct effects of the action alternatives would be a reduction in the amount of snags in the areas where harvesting is proposed. Snag numbers would be substantially reduced from existing conditions to 2 to 5 snags 15 inches DBH or larger, where available, in harvest areas *(see TABLES E-2 through E-6)*. If trees of that size class were not available, the largest snags available would be retained. Western larch and Douglas-fir snags would be favored. Trees that are more than 200 feet from an open road would be favored for retention. At least 50 percent of the existing snags would be retained in the SMZs in harvest units. Snags would be retained in a clumpy distribution when possible. This reduction of snags would take place over approximately 1,202 acres with Action Alternative B; 912 acres with Action Alternative C; 850 acres with Action Alternative D; and 561 acres with Action Alternative E. The proposed Unit 1SC currently has the greatest number of snags with a dbh of 15 inches or larger, with an estimated average of 18 snags per acre. Unit 1SC is proposed for salvage harvesting in Action Alternatives B and D. These 2 alternatives also propose the harvesting of beetle-killed and infested Douglas-fir over approximately 109 acres. Within this additional 109 acres, snag reduction would be limited to a

small percentage of the Douglas-fir in the overstory.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A on Snag Amounts and Distribution***

  Indirect effects of No-Action Alternative A on snag amounts and distribution may be an increase in snags in stands adjacent to the fire perimeter due to increased bark-beetle mortality. Snags amounts would also increase within the fire perimeter as tree mortality from bark beetle attack occurs.

- ***Indirect Effects of Action Alternatives B, C, D, and E on Snag Amounts and Distribution***

  The indirect effects to snags of implementing the action alternatives would be a reduction in new snag recruits over a long period of time, because many of the trees that were burned and weakened would be harvested. Many of these trees would likely die and become snags if they were not harvested. All action alternatives are designed to reduce the risk of bark beetle mortality to adjacent mature stands, which would reduce the potential number of new snags outside the fire perimeter over the short term.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Snag Amounts and Distribution***

  The cumulative effects of No-Action Alternative A to snag amounts would be short-term increases of tree mortality from trees that were damaged, but not directly killed, in the fire, creating additional snags.

- ***Cumulative Effects of Action Alternatives B, C, D, and E on Snag Amounts and Distribution***

  The cumulative effects to snags include the recent harvesting of the Moose Fire Salvage and Reforestation Project - Phase I, Cyclone Ridge Fire Salvage, and Cyclone/Coal '99 Timber Harvest Project, which reduced the amount of snags in a similar way to the proposed Moose Fire Salvage and Reforestation Project - Phase II. These sales covered approximately 1,433 acres.

COARSE WOODY DEBRIS AND FIRE HAZARDS

Direct Effects

- ***Direct Effects of No-Action Alternative A on Coarse Woody Debris and Fire Hazards***

  No-Action Alternative A would not directly affect the current amount of down woody material and fire hazard.

- ***Direct Effects of Action Alternatives B, C, D, and E on Coarse Woody Debris and Fire Hazard***

  The direct effects of all action alternatives would be the reduction of both down woody material and fire hazards within the proposed harvest units and over the specific acres treated with each action alternative. Salvage harvesting would include the removal of some woody debris that is currently on the ground and most of the snags and dying trees that would likely fall in the near future. This harvesting would substantially reduce stand density and ladder fuels in areas that experienced mixed-severity burns. The amount of coarse woody debris retained in harvest units would fluctuate, depending on the current conditions, severity of burn, etc. Retention of approximately 10 to 15 tons per acre of downed woody debris is planned in all proposed harvest units.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A on Coarse Woody Debris and Fire Hazards***

  The indirect effects of No-Action Alternative A would be a substantial increase in both fire hazard and amounts of coarse woody debris in the area that was burned as damaged and dead trees fall. Areas that experienced mixed-severity burns would have the greatest increase in fire hazard as trees fall because there are still many fine fuels in the dead crowns of standing trees and more ladder fuels in these stands. With no harvesting, coarse woody debris loadings could reach well over 100 tons per acre across a substantial amount of acres. No-Action Alternative A would likely result in increased bark beetle activity and mortality outside the fire perimeter adjacent to the bark beetle outbreaks. This additional mortality will cause an increase in coarse woody debris and fire hazards as trees die and fall.

- ***Indirect Effects of Action Alternatives B, C, D, and E on Coarse Woody Debris and Fire Hazards***

  The indirect effects from the action alternatives would include a reduction of trees that were burned and could, over the long term, contribute to the amount of down woody debris. The fire hazard would likely be reduced for several decades in all proposed harvest units.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Coarse Woody Debris and Fire Hazards***

  The cumulative effects to No-Action Alternative A would be a build-up of coarse woody debris and an increased risk of fire hazards in areas within the fire perimeter that were not treated with the Moose Fire Salvage and Reforestation Project - Phase I or other recent harvests.

- ***Cumulative Effects of Action Alternatives B, C, D, and E on Coarse Woody Debris and Fire Hazard***

  The cumulative effects of the reduction of down woody debris and fire hazards from the Moose Fire Salvage and Reforestation Project—Phase II proposal would include approximately 1,433 acres that have had similar reductions from recent harvesting, including the Moose Fire Salvage and Reforestation Project—Phase I.

OLD GROWTH

Direct Effects

- ***Direct Effects of No-Action Alternative A to Old Growth***

  No-Action Alternative A would not be expected to directly affect the amount, distribution, and character of old-growth stands in the analysis area.

- ***Direct Effects of Action Alternatives B and D on Old Growth***

  The direct effects of Action Alternatives B and D include the salvage harvesting of approximately 398 acres that currently meet the old-growth definition. There is approximately 3,574 acres of old growth on Coal Creek State Forest. Although approximately 382 acres of proposed harvesting would retain the minimum number of large-diameter trees required to meet the old-growth definition, these areas are not considered old growth after harvesting for the purpose of this analysis. Action Alternatives B and D would reduce the total acreage of stands that meet the old-growth definition on Coal Creek State Forest by 398 acres, from 3,574 acres to 3,176 acres, or approximately 11 percent. The harvest units, cover types, and estimated old-growth acres that are proposed for

TABLE E-10 - COVER TYPE AND ATTRIBUTE LEVEL OF OLD-GROWTH UNITS PROPOSED FOR HARVESTING

HARVEST UNIT	CURRENT COVER TYPE	ACRES	ATTRIBUTE LEVEL PRIOR TO THE MOOSE FIRE
1SC	Mixed conifer	260	High
Portion of 13W	Douglas-fir	12	High
Portion of 28W	Western larch/Douglas-fir	13	High
6CR	Western white pine	4	High
Douglas-fir bark-beetle salvage area	Douglas-fir	28 81	High Medium

salvage harvesting under Action Alternatives B and D are shown in *TABLE E-10 - COVER TYPE OF OLD-GROWTH UNITS PROPOSED FOR HARVESTING*.

The harvesting proposed under Action Alternatives B and D in the 109 acres of Douglas-fir old growth north of the fire perimeter on Winona Ridge would be limited to recent mortality from bark beetles and trees that have signs of a current successful attack (boring dust around the bole of the trees). This prescription is not expected to remove a large percentage of the overstory. Proposed salvage harvesting prescriptions in the remaining 289 old-growth acres would retain many large western larch and some Douglas-fir (see *TABLES E-2* through *E-6*). Live trees in these tables would remain after harvest, as well as some snags (see *SNAG AMOUNT AND* DISTRIBUTION discussion). Pockets of timber stands that did not burn will not be harvested. Stand structure after harvesting would be predominantly in a single-storied open condition. A minimum of 10 to 15 tons of coarse woody debris would be retained. It is estimated that the overall attribute levels of these 289 acres would range from medium to low following the proposed harvesting.

Several approaches to estimating historic or naturally occurring old-growth amounts have been explored. Previous efforts to estimate amounts of old growth that historically occupied the landscape in the North Fork of the Flathead River Valley and Coal Creek State Forest include:

- The FNF Plan Amendment 21 (1998) where an estimate of approximately 29 percent of the subbasin was occupied by late seral age classes;
- Lesica (1996) in an effort to use fire history to estimate the proportions of old-growth forests in the North Fork of the Flathead River basin estimated that approximately 38 percent of the area was occupied by stands that were 180 years old or older;
- Using cover-type conditions and historical data from the 1930s, summarized by Losensky (1997), it was estimated that approximately 28.8 percent of the forested acres in Coal Creek State Forest would amount to the historic conditions occupied by old growth (Cyclone/Coal DEIS 1998).

Thus, estimates of the amount of naturally occurring old growth for Coal Creek State Forest ranges from 28.8 to 38 percent. If Action Alternative B or D were harvested, approximately 21 percent of Coal Creek State Forest's forested land that meets

the old-growth definition would be remaining.

- ***Direct Effects of Action Alternatives C and E on Old Growth***

  Neither Action Alternative C or E was designed to enter stands that currently meet the old-growth definition; therefore, no direct effects to old growth are expected.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Old Growth***

  The indirect effects of No-Action Alternative A on old-growth stands would primarily be a change in the character of the stands within the fire perimeter and, potentially, over time, stands that are adjacent to the fire perimeter. There will be a substantial increase in down woody debris, snags, and, potentially, bark beetle populations. In the South Coal area, some stands adjacent to the burned stands have a high percentage of Engelmann spruce in the overstory. If a spruce bark-beetle infestation builds up within the fire perimeter, many of the large-diameter spruce in the adjacent stands could be killed, which would change the stand character substantially and, potentially, remove it from the classification of old-growth. Old-growth stands (approximately 935 acres) with stocking and species composition similar to the burned old-growth stands continue across the slope to the west into the South Coal area. These stands have substantial numbers of large-diameter Engelmann spruce and Douglas-fir that would be at risk from bark beetle build-ups in the adjacent burned area. In addition, approximately 409 acres of old-growth stands located along the Coal Creek riparian area, just downslope from the burned area in South Coal, have a high percentage of large Engelmann spruce (up to 80 percent of the species mix. Spruce bark beetle attacks have caused from 60 to 80 percent mortality in spruce stands over vast areas.

- ***Indirect Effects of Action Alternatives B, C, D, and E on Old Growth***

  The indirect effects of the action alternatives to old-growth stands are, primarily, potential effects to stands adjacent to the burned old-growth stands in South Coal and on the northwest portion of Winona Ridge, where the potential risk of bark-beetle infestations is high. Action Alternatives B and D would remove many of the burned host trees in these high-risk stands and reduce the potential for increased mortality from attacks by bark beetles in adjacent unburned old-growth stands. Action Alternatives C and E would not salvage trees in these high-risk stands or reduce the potential risk of bark-beetle infestations in adjacent unburned old-growth stands.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Old Growth***

  The same changes to character and increased tree mortality that are expected to occur in No-Action Alternative A would also occur in unburned stands that currently have high populations of bark beetles.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Old Growth***

  The cumulative effects to old growth, in addition to the action alternatives, would include harvesting in 151 acres of old growth in the Cyclone/Coal '99 Timber Harvest Project. This action removed approximately 151 acres of old growth in the mixed-conifer cover type from Coal Creek State Forest. This was accounted for in the existing condition

calculations.

NOXIOUS WEEDS

Direct Effects

- ***Direct Effect of No-Action Alternative A to Noxious Weeds***

  The wind, birds and animals, administrative vehicles, and recreationalists and their vehicles may spread noxious weed seeds that exist or are introduced within the burned area. Monitoring, mapping, and treating existing populations of noxious weeds will be a priority for Stillwater State Forest. Federal funding, as a direct result of the Moose Fire, will be applied to the task, along with regular DNRC forest-improvement funds. DNRC and Flathead County Weed Department personnel will develop a plan to map weed locations and monitor and treat existing populations with, mainly, herbicide applications. Depending on the monitoring results, additional funding may be requested for future weed control.

- ***Direct Effect of Action Alternatives B, C, D, and E to Noxious Weeds***

  The action alternatives propose to operate harvesting and yarding equipment, logging trucks, and personal and administrative vehicles on existing road systems within the burned area. Additional mineral soil would be exposed during the operation of this equipment within the proposed harvest units in the burned area during the blading of existing roads and the construction of log landings and temporary roads.

  Measures that would be implemented to reduce the establishment of additional weed populations include:

  - Surface blading to remove weeds before the seed-set stage on existing road systems affected by the proposal.
  - Intense monitoring, mapping, and treatment of existing populations near harvesting activities.
  - Eliminating weed seeds on all tracked and wheeled equipment by pressure cleaning prior to beginning operations; the officer administrating the contract will inspect equipment periodically during project implementation.
  - Revegetating promptly disturbed roadside sites; roads used and closed will be reshaped and grass seeded.

Indirect and Cumulative Effects

- ***Indirect and Cumulative Effects of All Alternatives to Noxious Weeds***

  The Moose Fire created a variety of weed seedbeds over a large area. All aspects of the fire, included, but not limited to, suppression, rehabilitation, timber salvaging, road maintenance, administration, weather, birds and animals, and public/recreational visits will contribute to the spread and establishment of noxious weeds in this area.

  Intense monitoring, mapping, and treatment of existing populations and new-population establishment areas will be part of a long-term management strategy. Noxious weed occurrences should decrease over time. Monitoring over the next several growing seasons will determine if additional needs, money, or manpower are required.

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

APPENDIX F

WILDLIFE ANALYSIS

INTRODUCTION

The existing environment and changes to that environment due to each alternative are discussed in this section. This description occurs on 2 scales. The project area includes all DNRC-managed lands within the Moose Fire perimeter, along with the proposed harvest unit adjacent to the fire perimeter on Winona Ridge. Full descriptions for the project area and proposed harvest units are presented in Chapter II. The second scale relates to the surrounding landscape for assessment of cumulative effects. This scale varies according to the species being discussed. Under each grouping or species heading, the description for the cumulative-effects analysis area will be discussed. In the cumulative-effects analysis area, prior and foreseeable future State actions were considered and discussed. Species were dismissed from further analysis if habitat for that species did not exist in the project area or would not be modified by any alternative.

The effects of fire severity will be discussed in this analysis. Fire severity refers to the amount of tree mortality due to a fire. Three terms were used to describe the effects of the fire on tree mortality. "Severe" and "stand replacement" refer to areas where nearly all the trees were killed by the fire. "Mixed severity" refers to areas of this fire where a combination of underburning, flare-ups, and small (several acres) stand-replacement fire runs occurred.

EXISTING ENVIROMENT

COARSE FILTER

DNRC assumes that if landscape patterns and processes similar to those that species adapted to are maintained, the full complement of species will be maintained across the landscape *(DNRC 1996)*. This "coarse filter" approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate historic conditions across a landscape (refer to *APPENDIX E – VEGETATION ANALYSIS)*.

The project area consists of DNRC-managed lands; 6,867 acres within the Moose Fire perimeter, plus 109 acres

TABLE OF CONTENTS

Introduction 1
Existing Environment 1
  Coarse Filter 2
  Fine Filter 5
    Threatened and Endangered Species 5
    Sensitive Species 28
    Big Game 42

adjacent to the fire perimeter. Of these acres, 6,753 acres of forested habitats burned at stand-replacement (3,737 acres) and mixed-severity (3,016 acres) intensities. The area adjacent to the fire continues to experience high mortality of Douglas-fir due to attacks by bark beetles. Prior to the this wildfire, the area provided habitat for a variety of forest-dwelling species. The project area also provided approximately 1,464 acres of old forested habitat (over 150 years old). Of the old-forest acres that burned, 1,152 acres met the old-growth definition *(Green et al. 1992)* using DNRC's SLI data. After the fire, DNRC personnel field verified the old-growth status of stands considered or proposed for harvesting.

Mammals and birds are seldom killed in wildfires *(French and French 1996)*. Mobile animals, such as large mammals and birds, move away from fires; however, a female grizzly bear was killed in this fire. Some smaller animals might escape the fire by burrowing underground. In rare cases, animals might be trapped and succumb to the fire *(Bendell 1974, French and French 1996)*. Animals with small home ranges and low mobility were most affected by the fire.

The fire dramatically changed the habitats available on 6,753 acres in the area, resulting in a change of use by wildlife species in the area. The fire changed forested habitat to open, snag-abundant habitat on approximately 3,551 acres where severe burning occurred. On 2,937 acres, where mixed-severity fires occurred, the age class of the stands remained the same as prefire, but snag density increased and canopy cover decreased due to the fire effects. The remaining 265 acres of the mixed-severity fire area were in early seral condition prior to the fire. In these areas, the fire set back regeneration and plant succession. The wildfire killed and weakened trees, along with consuming understory vegetation, while opening up the tree canopy. These conditions provide habitat for wildlife species that use early- to mid-seral vegetation communities and species that use burned or weakened trees for foraging and nesting.

The Moose Fire burned approximately 72,000 acres of USFS, NPS, State, and private lands in the North Fork of the Flathead River drainage. To assess cumulative effects, Coal Creek State Forest was used for the coarse-filter analysis, recognizing the remaining burned habitat outside the analysis area. In this analysis area, prior to the Moose Fire, several other events occurred. In 1999, approximately 500 acres of timber were harvested along Coal Creek and Winona Ridge areas under the *Cyclone/Coal Timber Harvest Project EIS (1998)*. An additional 727 acres were planned for harvest in the future under this environmental analysis, but the Land Board did not approve these harvests. Most of the areas harvested or planned for harvest in the Cyclone/Coal Timber Harvest Project burned in the Moose Fire and are proposed for harvest under Action Alternatives B and D. Future harvests under the *Cyclone/Coal Timber Harvest Project EIS* are not expected. In 2000, the Cyclone Ridge Fire burned approximately 200 acres on Coal Ridge. In 2001, DNRC salvaged timber from approximately 100 acres within the Cyclone Ridge Fire perimeter (*Cyclone Ridge Fire Timber Salvage EA 2001*).

Coarse Filter Effects

Direct Effects to Coarse Filter

- ***Direct Effects of No-Action Alternative A***

  Under this alternative, no additional direct effects to wildlife species using the area would be expected.

- ***Direct Effects Common to all Action Alternatives B, C, D, and E***

  Under theses alternatives, harvesting activities could occur between July and April. By mid-July, most wildlife species complete their reproductive and rearing activities and would be able to move from the area while harvesting occurs. Therefore, any direct effects are expected to be negligible.

Indirect Effects to Coarse Filter

- ***Indirect Effects of the No Action Alternative***

  This alternative would retain all snags and coarse woody debris. On average, 221 and 203 trees/snags per acre more than 5 inches dbh would be retained in mixed-severity and stand-replacement burn units, respectively *(Moose Fire Salvage and Reforestation Project 2001)*. This material would provide foraging, perching, and/or nesting sites for a host of wildlife species through time. Following the development of understory vegetation and regeneration of conifers, the species that use the area would change through time. The snags would eventually fall to the ground and provide habitat for a variety of mammal, bird, reptile, and amphibian species that require this habitat component to meet life requirements.

- ***Indirect Effects Common to Action Alternatives B and C***

  Under Action Alternatives B and C, dead and dying wood would be harvested over approximately 1,202 and 912 acres, respectively. Under Alternative B, dead and dying trees would be removed from an additional 109 acres outside the fire perimeter. Harvesting would remove large amounts of dead wood in the affected areas, but a minimum of 2 to 5 large (more than 15 inches dbh) snags/acre, live trees, cull trees, and unmerchantable material in the harvest units would be retained. Under these alternatives, approximately 19.7 and 3.1 live trees per acre more than 5 inches dbh, on average, would be retained in mixed-severity and stand-replacement-burn harvest units, respectively (refer *APPENDIX E - VEGETATION ANALYSIS, TABLE E-6* through *TABLE E-9*). In the Douglas-fir Bark Beetle Salvage Area, approximately 21 live trees per acre more than 5 inches dbh, on average, would be retained. The removal of the dead-wood component would reduce habitat structure in the units. However, the retained material would provide some habitat structure following harvesting, but less than under No-Action Alternative A. However, many other similar habitats are included in the project area; therefore the removal of this material is not expected to produce measurable effects to the wildlife species using the area, though some habitat shifts and localized impacts could occur through time. Although the effects are minor, the amount of area harvested increases the risk of impacts to species; therefore, Action Alternative B presents the highest risk of negative effects, followed by Action Alternatives D, C, and E, respectively.

- ***Indirect Effects Common to Action Alternatives D and E***

  Under Action Alternatives D and E, dead and dying wood would be harvested over approximately 850 and 560 acres, respectively. Under Action Alternative D, dead and dying trees would be removed from an additional 109 acres outside the fire perimeter. Harvesting would remove large amounts of dead wood in the affected areas, but a minimum of 2 to 5 large (more than 15 inches dbh) snags per acre, live trees,

cull trees, and unmerchantable material in the harvest units would be retained. Under Action Alternatives D and E, approximately 19.7 and 3.1 live trees per acre more than 5 inches dbh, on average, would be retained in harvest units of mixed-severity and stand-replacement burns, respectively (refer to *APPENDIX E - VEGETATION ANALYSIS, TABLE E-6* through *TABLE E-9*). In the Douglas-fir bark beetle salvage area, approximately 21 live trees per acre more than 5 inches dbh, on average, would be retained. The removal of the dead-wood component would reduce habitat structure in the units. However, the retained material would provide some habitat structure following harvesting, but less than under No-Action Alternative A. Many other similar habitats are included in the project area; therefore, the removal of this material is not expected to produce measurable effects to the wildlife species using the area, though some habitat shifts and localized impacts could occur through time. Although the effects are minor, the amount of area harvested increases the risk of impacts to species; therefore Action Alternative B presents the highest risk of negative effects, followed by Action Alternatives D, C, and E, respectively.

Cumulative Effects to Coarse Filter

- ***Cumulative Effects of No-Action Alternative A***

  Under this alternative, no salvage harvesting would occur in the cumulative-effects analysis area, resulting in approximately 5,981 acres (5,881 acres Moose Fire following Moose Fire Salvage and Reforestation Project - Phase I and 100 acres Cyclone Ridge) of unaltered burned habitat in Coal Creek State Forest. These areas would continue to provide high-density snag patches and downed-wood areas for species associated with dead-wood material. The amount of acres in early seral stages produced by the fire and past harvesting on Coal Creek State Forest would remain at 5,696 acres. Species that use early seral habitats benefited from fire disturbance and would not be negatively affected by this alternative. The relatively contiguous mixed-severity areas would likely continue to provide habitat for forest-dwelling species and provide movement corridors into the burned area for species that use a variety of seral stages. The severely burned interspersed habitats might inhibit movement of forest-dwelling species until adequate regeneration or mature forests develop. In all the burned areas, species that use dead wood or more open forests gained habitat due to fire-induced changes.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E***

  Under each action alternative, additional burned habitat would be harvested, resulting in areas with fewer snags and, in time, less downed wood. The action alternatives, combined with the salvage harvests of the Cyclone Ridge Fire Timber Salvage and Phase I of this project, would alter approximately 1,068 to 2,270 acres of burned habitat on Coal Creek State Forest (*TABLE F-1 - SUMMARY OF ACREAGE OF BURNED HABITAT HARVESTED AND PROPOSED FOR HARVESTING*). The removal of dead trees might allow large mammals easier travel through the harvested areas, but would reduce habitat for species that use dead wood. The amount of early seral habitats would remain essentially the same as the No-Action Alternative. Since unharvested burned habitats on DNRC and adjacent lands affected by the fire would be retained and

TABLE F-1 – SUMMARY OF ACREAGE OF BURNED HABITAT HARVESTED AND PROPOSED FOR HARVESTING

ALTERNATIVE	CYCLONE RIDGE	MOOSE PHASE I	PROPOSED MOOSE - PHASE II	TOTAL AFFECTED (%)
A	104	964	0	1,068 (15.4%)
B	104	964	1,202	2,270 (32.7%)
C	104	964	913	1,981 (28.5%)
D	104	964	850	1,918 (27.6%)
E	104	964	560	1,628 (23.4%)

harvests are not expected to change canopy closure or seral stages in the cumulative effects analysis area, the effects of either alternative are not expected to result in measurable effects to wildlife species.

FINE FILTER

In the fine-filter analysis, individual species that are recognized to be of special concern are evaluated. These species are addressed below and include wildlife species Federally listed as "threatened" or "endangered", species listed as "sensitive" by DNRC, and species managed as "big game" by DFWP.

Threatened and Endangered Species

Four species indigenous to northwestern Montana are classified as "threatened" or "endangered" under the Endangered Species Act of 1973. The bald eagle, Canada lynx, and grizzly bear are listed as "threatened", while the gray wolf is listed as "endangered".

➢ *Bald Eagle*

Strategies to protect the bald eagle are outlined in the *Pacific States Bald Eagle Recovery Plan (USFWS 1986)* and the *Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group 1994)*. Management direction involves identifying and protecting nesting, feeding, perching, roosting, and wintering/migration areas *(USFWS 1986, Montana Bald Eagle Working Group 1994)*. In some cases, a site-specific nest plan for a nest might be developed. The site-specific nest plan provides more detail and specific recommendations for management around a specific nest. *McFadzen (1992)* developed a *Site-Specific Nest Plan for the Cyclone Lake Nest Territory*.

Bald eagles prefer multistoried nesting habitats with 40 to 70 percent canopy cover and emergent trees within topographic line-of-sight to an associated water source that contains an adequate food supply. The emergent trees and/or snags need to be large enough (more than 25 inches dbh) to support nesting or perching eagles. Eagles prefer cottonwood, Douglas-fir, and ponderosa pine trees *(Wright and Escano 1986)*. In western Montana, eagles also use western larch and Englemann spruce. Bald eagles are sensitive to disturbance around their nest area between February and early August.

Documentation of bald eagles nesting on Cyclone Lake is sporadic prior to 1979. In 1979, a biologist initiated annual monitoring of this nest. Eagles occupied the nest 18 of 22 years (82 percent) and fledged 7 eaglets (0.39 eaglets/occupancy) resulting in a 39 percent success rate from 1979 to 2001. The last documented occupancy of this nest occurred in 1998, with the last successful nesting attempt occurring in 1996. The nest blew out in 1998 and was reconstructed in 2001. Presently, the nest appears to be in poor condition *(D.Burgeron, DFWP, personal communication, 2/02)*. Annual monitoring of this nest

will continue into the future.

For the cumulative-effects analysis, the home range discussed in the site-specific nest plan was used *(McFadzen 1992)*. The nest, primary-use, and home-range areas occur primarily on DNRC lands. The nest and primary-use areas receive dispersed recreational use throughout the year. During late winter and early spring, snowmobile use at Cyclone Lake occurs. To reduce disturbance to eagles during this time period, DNRC instituted a seasonal closure on the road to Cyclone Lake *(Cyclone Coal Timber Sale Project 1998)*. The Moose Fire and associated fire-suppression activities removed vegetation, which previously inhibited access to the lake from other directions. Removal of the vegetation might facilitate winter motorized use near the lake and increase disturbance to the nest area in late winter and early spring. To discourage use, slashing firelines and other trails occurred under immediate postfire-rehabilitation efforts in the autumn of 2001. These actions are expected to prevent unauthorized motorized use in the nonsnow periods, but the effectiveness during winter is uncertain.

The proposed harvesting might alter bald eagle habitat, while helicopter yarding might directly disturb eagles in their home range and along travel routes away from the nest. Units 6CM, 7CM, 6CR, 15W, 24W, 25W, and 29W occur within the Cyclone Lake Bald Eagle Territory defined by *McFadzen (1992)*. Additionally, 3 main eagle flight paths access the nesting area. One path occurs down Cyclone Creek; another more-traveled route occurs along the Coal Ridge face; and the most-used path from the nest occurs through the saddle between Cyclone Peak and Winona Ridge *(McFadzen 1992)*. The timber harvesting activities proposed might reduce eagle use of their primary use area and/or home range, resulting in reduced productivity of the nest territory.

Direct Effects to Bald Eagles

- ***Direct Effects of No-Action Alternative A to Bald Eagles***

  No direct effects are expected from this alterative.

- ***Direct Effects of Action Alternative B to Bald Eagles***

  Under this alternative, timber-salvage harvesting activities would entail helicopter yarding of Units 13W, 24W, 28W, and the Douglas-fir Bark Beetle Salvage Area. Several helicopter flight options are possible. If helicopter yarding of Units 13W, 28W, 24, and the Douglas-fir Bark Beetle Salvage Area entailed flight paths that crossed Cyclone Creek, eagles could be displaced from feeding sites along Cyclone Creek or disrupt flight patterns out of the area, thereby impacting food availability. The reduction in food availability could result in decreased eagle reproduction. If a landing site were established on the Winona temporary road for these units, no effects to eagles would be expected because activities would not occur in the areas eagles are using.

  The timing of the helicopter yarding over Cyclone Creek proposed under this alternative could alter the effects to bald eagles. Most likely helicopter yarding would occur after August 1. If helicopter yarding over Cyclone Creek occurred after fledging (August 1) and prior to nest building (February 1), or in a year that the nest is unoccupied or failed, no effects to nesting eagles would occur. Yarding during the nesting

season could result in displacement of eagles from feeding sites along Cyclone Creek or disruption of flight patterns out of the area, thereby impacting food availability. The reduction in food availability might result in decreased eagle reproduction. Other proposed units and ground-based harvest methods are not expected to conflict with eagle use of the nesting territory. If helicopter yarding of these units occurred outside the breeding season (February 1 through August 1) and in a year where the nest was inactive, or if flight paths do not cross Cyclone Creek, then no effects to eagle reproduction are expected.

- ***Direct Effects of Action Alternative C to Bald Eagles***

  The direct effects of Action Alternative C are the same as Action Alternative B, except the portions of Units 13W and 28W that meet *Green et al (1992)* and the Douglas-fir bark beetle salvage area would not be harvested. The reduction of 134 acres would reduce slightly the number of trips and the amount of time disturbance would be present. However, the difference is not expected to reduce the effects substantially. If the helicopter yarding of these units occurred outside the breeding season (February 1 through August 1) or in a year when the nest was inactive, or if flight paths do not cross Cyclone Creek, then no effects to eagle reproduction are expected.

- ***Direct Effects of Action Alternative D to Bald Eagles***

  Under this alternative, helicopter yarding of the Douglas-fir Bark Beetle Salvage Area and Unit 24W would occur. This alternative would increase disturbance over Action Alternative B by helicopter harvesting Unit 29W in the eagles home range. In addition, helicopter yarding of Units 13W and 28W would require helicopter flights across Cyclone Creek, resulting in further increased disturbance to the eagle's home range. This disturbance could result in displacement of eagles from feeding sites along Cyclone Creek or disruption of flight patterns out of the area, thereby impacting food availability. The reduction in food availability might result in decreased eagle reproduction. If the helicopter yarding of these units occurred outside the breeding season (February 1 through August 1) or in a year when the nest was inactive, or if flight paths do not cross Cyclone Creek, then no effects to eagle reproduction are expected.

- ***Direct Effects of Action Alternative E to Bald Eagles***

  Under Action Alternative E, the same units would be harvested as under Action Alternative D, with the exception of the Douglas-fir Bark Beetle Salvage Area and the portions of Units 13W and 28W that meet *Green et al. (1992)*. Removing these units from the alternative results in the removal of disturbance to the primary use area and reduced disturbance in the home range area. The removal of disturbance across the primary-use area is expected to substantially reduce the risk of displacing eagles from important feed sites, thereby reducing the expected effects to a minor level. The reduction in 25 acres of harvested area in disturbance across the home range area and a flight path is

not expected to result in substantially reduced effects; therefore, some unknown level of risk of reducing food availability still exists. However, the risk of affecting key foraging sites is small. The same effects discussed under Action Alternative D are expected, but to a slightly lesser degree. If the helicopter yarding of these units occurred outside the breeding season (February 1 through August 1) or in a year when the nest was inactive, or if flight paths do not cross Cyclone Creek, then no effects to eagle reproduction are expected.

Indirect Effects to Bald Eagles

- ***Indirect Effects of No-Action Alternative A to Bald Eagles***

  The Moose Fire burned the southern portion of the Cyclone Lake eagle home range area, resulting in vegetation changes. The fire removed canopy cover and killed many trees along the main streams in the area: Dead Horse, Coal, and Cyclone Creeks. These trees would provide potential perching sites now and in the future. Eagles might use these sites to forage in the associated creeks; however, no documentation of concentrated use on these streams is known. The value of these perch sites would increase as the trees in the burned area regenerate and visual screening develops. If bark beetle populations build and increase tree mortality as expected, snag density, especially Douglas-fir and Englemann spruce, would increase the availability of potential nest sites and roosts, while decreasing visual screening. Since these changes would occur outside the nesting area and the primary use area, the effects are expected to be minor. Under this alternative, the greatest amount of trees and snags available for nesting, roosting, and perching would be retained. No additional effects to nesting eagles are expected from this alternative.

- ***Indirect Effects of Action Alternative B to Bald Eagles***

  The proposed salvage harvest would remove many dead trees from the project area. Most of the removal would occur outside the bald eagle home range, with no harvesting proposed in the nest or primary use areas. In this alternative, 189 acres of timber would be harvested from the bald eagles home range in Units 6CM, 7CM, 6CR, 15W, 24W, 25W, and 29W. Of these stands, only Units 6CR (4 acres), 15W (57 acres), and 24W (17 acres) offer potential perching and roosting sites. The other stands do not provide large enough trees.

  Proposed harvesting would remove dead trees or trees not expected to survive into the near future. No harvesting is proposed in areas expected to provide alternative nest sites or in areas within 150 feet, and, in most cases, over 250 feet, from Cyclone Creek, thereby not reducing potential nesting habitat and retaining high densities of snags along feeding sites. However, harvesting might affect the availability of perching and roosting sites. Units 15W (57 acres) and 6CR (4 acres) experienced high mortality; therefore, salvage harvesting would remove a high proportion of dead trees in these units. A minimum of 2 to 5 large snags per acre (favoring large, shade-intolerant species), cull trees, and trees expected to live would be retained to provide potential perching and roosting sites in

the harvest units. In Unit 24W, tree mortality occurred in a patchy distribution; therefore, more cover and potential perch sites (live trees) are expected to be retained in this unit. Additionally, 2 to 5 large snags per acre would be retained in this harvested area. The reductions of habitat expected do not appear to affect alternative nest sites, foraging opportunities, or the ability of the eagle territory to support a pair of nesting eagles; therefore, the effects are expected to be minor.

- ***Indirect Effects of Action Alternative C to Bald Eagles***

  This alternative proposes harvesting the same units with the same prescription in eagle habitat as would Action Alternative B, except Unit 6CR (4 acres) would be dropped. This unit provides some large trees that, potentially, could be used as perching, roosting, or nesting sites. This unit is located almost a quarter of a mile from Cyclone Creek near an open road; therefore, the area is probably of marginal importance to eagles. Additionally, the unit only incorporates 4 acres; therefore, this reduction is small and does not substantially alter the effects discussed in Action Alternative B.

- ***Indirect Effects of Action Alternative D to Bald Eagles***

  This alternative proposes to harvest the same units with the same prescription in eagle habitat as does Action Alternative B, except Units 6CM and 25W would not be harvested. These units do not appear to provide potential perch or roost sites nor high amounts of visual screening; therefore, the effects discussed under Action Alternative B hold for this alternative.

- ***Indirect Effects of Action Alternative E to Bald Eagles***

  This alternative proposes harvesting the same units with the same prescription in eagle habitat as does Action Alternative C, except Units 6CM and 25W would not be harvested. These units do not appear to provide potential perch or roost sites nor high amounts of visual screening; therefore, the effects discussed under Action Alternative C hold for this alternative.

Cumulative Effects to Bald Eagles

- ***Cumulative Effects of No-Action Alternative A***

  Under this alternative, no additional disturbance is expected. Continued public use of the area would occur. Snowmobiling is expected to continue on Cyclone Lake, resulting in disturbance to nesting eagles in late winter and early spring. This situation might increase due to the fire removing vegetation that made it more difficult to access the lake in the past. No further reductions in perch and roost sites would occur. If bark beetle populations build and increase tree mortality as expected, snag density, especially Douglas-fir and Englemann spruce, would increase potential nest, perch, and roost sites, while decreasing visual screening. Over time, these dead trees would fall and not be replaced for a long period of time; thus, snag abundance would naturally decline over time. No other activities are planned within the bald eagle territory.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E***

  The disturbances described under the direct effects for each action alternative would occur and be additive to the disturbance presently occurring, primarily dispersed recreational use and late winter/early spring snowmobiling. Mushroom picking is not expected to affect bald eagles because only a small portion of the primary-use area would be impacted and the disturbance would be primarily from the ground. No increase in disturbance in the nest area would be expected. No other activities are planned or are occurring in the eagle territory. Each action alternative alters habitat in the eagle territory slightly by removing potential roost and perch trees. In combination with Phase I of this project, some reductions in available perch and roost trees would occur, though these areas are small and in marginal habitat; therefore, no measurable effect on breeding success or survivability of young is expected from this phase of the project.

➢ *Canada Lynx*

Canada lynx are listed as "threatened" under the Endangered Species Act. Currently, no recovery plan exists. Several reports have been written to summarize the research on lynx and develop a conservation strategy *(Ruediger et al. 2000, Ruggiero et al. 2000)*.

Lynx are associated with subalpine fir forests generally between 4,000 to 7,000 feet in elevation in western Montana *(Ruediger et. al 2000)*. Lynx habitat in western mountains consists primarily of young coniferous forests with plentiful snowshoe hares, mature forests for denning and cover for kittens, and densely forested cover for travel and security. Additionally, the mature forests provide habitat for red squirrels, an alternative prey source. These conditions are found in a variety of habitat types, particularly within the subalpine fir series.

To assess lynx habitat, DNRC used SLI data to map habitat types used by lynx *(Ruediger et al. 2000)*. These areas were considered lynx habitat. Other data (canopy cover, amount of coarse woody debris, etc.) aided in modeling the availability of specific lynx habitat in the area (such as denning, forage, and other habitat temporarily not available). Young forage consisted of regenerating stands less than 39 years old in a well-stocked condition (more than 1,500 trees per acre). Mature forage included all stands in lynx habitat that were greater than 40 years old with more than 40 percent canopy closure. Denning habitat consisted of mature stands (more than 100 years old) with more than 40 percent canopy closure and a high amount of coarse woody debris present. Temporary nonhabitat included all stands with regeneration less than 15 years old, stands that received precommercial thinning within the last 10 years, and stands with less than 40 percent canopy closure.

Based on the above analysis, lynx habitat comprised approximately 6,010 acres of habitat on DNRC lands within the fire perimeter. Of these acres, 929 acres of denning habitat, 2,249 acres of mature foraging habitat, and 183 acres of young foraging habitat existed in the project area prior to the Moose Fire. Where the wildfire burned at stand-replacement intensity, the habitat is considered temporarily unusable by lynx until the fire area

regenerates to provide cover and snowshoe hare habitat. However, areas that burned at mixed-severity intensity were considered habitat suitable for lynx use. These areas would potentially promote lynx use and access to young foraging sites in the future.

Cumulative effects were analyzed for DNRC-managed lands in the State Cyclone Coal Grizzly Bear Subunit. In the cumulative-effects analysis area, approximately 12,640 acres of lynx habitat occurs. Prior to the Moose Fire, 3,195 acres (25 percent) of denning habitat, 2,791 (22 percent) of mature forage habitat, and 732 acres (6 percent) of young forage habitat existed on Coal Creek State Forest within the State Cyclone Coal Grizzly Bear Subunit. The remaining 5,922 acres provide lynx travel habitat. The fire consumed 416 acres of denning and 1,025 acres of mature foraging habitats. In time, young foraging habitat is expected to develop on 3,737 acres. The fire burned in a mosaic pattern, which might allow lynx to use less severely burned patches to access young-forested foraging areas as they regenerate in the future.

Within the next 2 decades, young forage habitat is expected to develop on approximately 3,737 acres that burned at stand-replacement intensities. Within these areas, coarse woody debris would provide security for kittens during hunting forays. As the stands age and canopy closure increases, the down woody debris would provide denning habitat. In the mixed-severity burned areas, denning habitat for lynx might continue to be available, and shrubs in the understory preferred by snowshoe hares would develop, providing foraging opportunities for lynx.

Direct Effects to Canada Lynx

- ***Direct Effects of No-Action Alternative A to Canada Lynx***

  No additional activities would occur; therefore, no direct effects would be expected.

- ***Direct Effects Common to Action Alternatives B, C, D, and E to Canada Lynx***

  Some disturbance of lynx could occur in areas with adequate cover for lynx to travel through. However, lynx appear to be relatively tolerant of human presence and road use *(Mowat 2000)*; therefore, no substantial direct effects would be expected. A slight potential increase for mortality due to road traffic on gated and/or new roads would be possible; however, the risk of this occurring is expected to be extremely small. Lynx do not appear to avoid roads at low traffic volumes *(Ruediger 2000)*, so increased logging traffic on open and gated roads is not expected to displace or increase the energetic cost of individual lynx. This might not be the case if a den site occurs near a haul route *(Ruggiero et al. 2000)*. However, harvesting activities are not expected to take place during denning (May through June); therefore, no increased risk is associated with road use. In each action alternative, some disturbance might occur; however, that disturbance is expected to result in minor effects to lynx.

Indirect Effects to Canada Lynx

- ***Indirect Effects of No-Action Alternative A to Canada Lynx***

  This alternative would not alter existing burned habitat any further. The areas that burned are expected to accrue large amounts of down woody debris

over time. In areas that endured hot stand-replacement intensities, most coarse woody debris was consumed. In areas that received less intense fires, coarse woody debris burned to some degree. In areas of mixed-severity fire, underburn or unburned areas exist in combination with the above scenarios, leading to areas of varying amounts of coarse woody debris. The amount of tree mortality will positively affect recruitment of coarse woody debris in the near term, but will negatively affect recruitment over the long term. In areas that experienced high tree mortality, a large increase in coarse woody debris will occur over the next several decades. Conversely, future recruitment of coarse woody debris will be limited until the stand starts to produce larger trees in 80 to 100 years. In the mixed-severity burns, the short-term fire effects are expected to add to coarse woody debris, but continued recruitment is expected into the future. The presence and recruitment of this material would provide security cover and denning habitat in the future. This alternative would allow for the greatest development and abundance of potential future denning habitat of the alternatives considered.

- ***Indirect Effects of Action Alternative B to Canada Lynx***

  Under this alternative, denning habitat quality would be reduced on approximately 184 acres. Prior to the fire, denning habitat existed in proposed Units SC1 and CR6 (184 acres). The fire burned at mixed-severity intensity in these units, so coarse woody debris and canopy cover are still present in amounts believed to be useable by lynx. The proposed harvests would remove lynx denning-habitat attributes by removing merchantable downed wood, standing dead trees, and trees with foliage that are expected to die in the short-term. Concentrations of downed wood can provide security structure for lynx kittens, while the standing trees (live and snags) provide for downed wood recruitment through time. The standing trees with foliage continue to provide canopy closure. However, these live trees that would be removed by the harvest would likely die in the short-term, resulting in similar effects in canopy reduction. Therefore, any reduction in canopy cover is expected to be short-term and negligible. Removal of these structures would reduce the quality of current lynx denning habitat and reduce recruitment of needed coarse woody debris for denning in the future. These areas are near stand-replacement burned areas that are expected to provide foraging habitat in the future. However, both units experienced a mixed-severity burn, so harvesting would not remove all material for denning structure, resulting in maintenance of some denning habitat in the near term.

  In the longer term, timber harvesting would remove future denning material from the project area. Harvesting in the other proposed units would reduce coarse woody debris and coarse-woody-debris recruitment, preventing development of denning habitat on 1,016 acres until the distant future.

  Proposed harvesting is not expected to appreciably affect foraging habitats or lynx movement through the project area. The fire removed high amounts of canopy cover in most

of the proposed units, thereby removing cover. Additionally, harvesting would focus on dead and dying trees; therefore, additional long-term canopy cover is not expected to be removed. In Unit SC1, a 165-foot buffer would be left along each side of one perennial stream to provide potential future denning habitat and maintain a high amount of cover in the short-term to facilitate movement through the project area. This perennial stream occurs along the western edge of the unit and runs through an old regeneration unit. Since, existing forage habitat and cover would not be altered appreciably, no additional measurable effects are expected. Under this alternative, some habitat shifts or local impacts could occur through time, but these effects are expected to be minor.

- ***Indirect Effects of Action Alternative C to Canada Lynx***

  Under this alternative, no existing denning habitat would be affected. However, timber harvesting would reduce development of future denning habitat on 912 acres in the proposed units. Harvesting is not expected to appreciably affect foraging habitats or lynx movement through the project area. The fire removed high amounts of canopy cover in most of the proposed units, thereby removing cover. No short-term effects to denning, forage, or travel habitats are expected under this alternative, but some long-term reductions in denning-habitat quality are expected. Therefore, some habitat shifts could occur through time, but no other effects are expected.

- ***Indirect Effects of Action Alternative D to Canada Lynx***

  Under this alternative, the effects to existing denning habitat discussed under Action Alternative B would occur. Additionally, the timber harvest would reduce development of future denning habitat on 859 acres in the proposed units. Harvesting is not expected to affect foraging habitats or lynx movement through the project area to a measurable degree. Therefore, harvest activities are not expected to appreciably affect short-term denning habitat, foraging habitats, or lynx movement through the project area. Under this alternative, some reductions in short-term and long-term denning would occur, but harvesting is not expected to affect foraging areas or lynx movement through the area. Therefore, some localized impacts could occur, but these effects are expected to be minor.

- ***Indirect Effects of Action Alternative E to Canada Lynx***

  Under this alternative, no existing denning habitat would be harvested. Timber harvesting would reduce development of future denning habitat on 560 acres in the proposed units. No short-term effects to denning, forage, or travel habitats are expected under this alternative, but some long-term reductions in denning-habitat quality are expected. Therefore, some habitat shifts could occur through time, but no other effects are expected.

Cumulative Effects to Canada Lynx

- ***Cumulative Effects of No-Action Alternative A to Canada Lynx***

  In time, this alternative is expected to provide more denning habitat than any action alternative. Denning habitat is abundant on the northern portion Coal Creek State Forest (23.8 percent), and some still exist in mixed-severity areas of the burn. Young foraging habitats will increase in time due to fire effects. The increase in denning habitat is not expected to result in increased effectiveness of the area for lynx due to the abundance of habitat in the cumulative effects analysis area (25.3 percent). The development of forage habitat is expected to enhance prey availability and lynx survival and reproduction in the long-term (20 to 50 years).

- ***Cumulative Effects of Action Alternatives B and D to Canada Lynx***

  Under these alternatives, some losses in existing denning habitat would be expected, and development of new denning habitats would be reduced in the future by removing burned trees. Existing denning habitat on DNRC-managed lands in the State Cyclone Coal Grizzly Bear Subunits would be reduced from 25.3 to 23.8 percent. The combined effects of timber removal proposed under Action Alternatives B and D and harvesting areas within Phase I of this project, the Cyclone/ Coal Timber Harvest Project, and Cyclone Ridge Fire Salvage would be expected to have minimal impact on near-term use of the area by Canada lynx. Over the long-term (more than 30 years) large-woody-debris reductions that would result from the proposed timber-salvage activities would be expected to reduce the potential abundance of future den sites across 1,018 acres under Action Alternative B and 729 acres under Action Alternative D by reducing structure and security important for the successful rearing of kittens. The impacts of these reductions in coarse woody material over the long term would be expected to result in minor adverse effects to lynx, because habitat conditions are not likely to be limiting within Coal Creek State Forest; that is, 677 acres of mature forest would remain unsalvaged under either alternative and serve as a future source of denning structure, and 3,011 acres of existing denning habitat would remain posttreatment, which would ensure that ample amounts would be retained in a relatively scattered distribution. Retained amounts would exceed recommendations contained in the Lynx Conservation Assessment Strategy at a lynx home-range scale *(Ruediger et. al 2000)*.

  The implementation of these alternatives is not expected to affect the amount of foraging habitat in the short or long term. The fire caused an increase in the amount of conifer stands expected to regenerate over the next several decades, in addition to those stands converted by the Cyclone Ridge Fire and past harvests on Coal Creek State Forest. When these stands regenerate enough to support snowshoe hares, lynx survival and reproduction is expected to increase. Implementation of either alternative would not change the rate or amount of forage developed, nor limit the amount of denning habitat to reduce denning rates; therefore, these alternatives are expected to

result in negligible effects to lynx.

Salvage harvesting and firewood cutting on ownerships neighboring State land could occur over the next several years, which could create cumulative added risk to lynx and their habitat. However, this risk is expected to be low, particularly in the context of the cumulative effects analysis area, as denning habitat is likely to remain abundant for the next several decades at the scale of this local landscape. Cumulative disturbance associated with such activities, as well as existing dispersed recreation and increased (albeit uncertain) levels of mushroom picking for the next several years could have additional minor impacts on lynx. However, as lynx are relatively tolerant of human disturbance, the combined cumulative risk is expected to be low.

- ***Cumulative Effects of Action Alternatives C and E to Canada Lynx***

  Denning habitat would not be altered and would be maintained at 25.3 percent of existing lynx habitat on DNRC-managed lands within the State Cyclone Coal Grizzly Bear Subunit. The combined effects of timber removal proposed under Action Alternatives C and E and harvested areas within Phase I of this project, the Cyclone Coal Timber Harvest Project, and Cyclone Ridge Fire Salvage would be expected to result in minimal impacts on near-term use of the area by lynx. Over the long-term (more than 30 years) large-woody-debris reductions that would result from salvage logging activities would be expected to reduce the potential abundance of future den sites across 912 acres under Action Alternative C and 561 acres under Action Alternative E by reducing structure and security important for successful rearing of kittens. The impacts of these reductions in coarse woody material over the long term would be expected to result in minor adverse effects to lynx, because habitat conditions are not likely to be limiting within Coal Creek State Forest; that is, 692 acres of mature forest would remain unsalvaged under either alternative and serve as a future source of denning structure, and 3,195 acres of existing denning habitat would remain posttreatment, which would ensure that ample amounts would be retained in a relatively scattered distribution. Retained amounts would exceed recommendations contained in the Lynx Conservation Assessment Strategy at a lynx home-range scale *(Ruediger et. al 2000)*.

  The implementation of either of these alternatives would not be expected to affect the amount of foraging habitat. The fire caused an increase in the amount of nonforested stands, in addition to those converted by the Cyclone Ridge Fire and past harvests on Coal Creek State Forest that are likely to regenerate over the next 2 decades. When these stands regenerate enough to support snowshoe hares, lynx survival and reproduction is expected to increase. Implementation of either alternative would not change the rate or amount of forage developed, nor limit the amount of denning habitat to reduce denning rates; therefore, these alternatives are expected to result in negligible effects to lynx.

  Salvage harvesting and firewood cutting on ownerships neighboring State land could occur over the next several

years, which could create cumulative added risk to lynx and lynx habitat. However, this risk is expected to be low, particularly in the context of the cumulative-effects analysis area, as denning habitat is likely to remain abundant for the next several decades at the scale of this local landscape. Cumulative disturbance associated with such activities, as well as existing dispersed recreation and increased (albeit uncertain) levels of mushroom picking for the next several years could have additional minor impacts on lynx. However, lynx are relatively tolerant of human disturbance; therefore, the combined cumulative risk is expected to be low.

➢ Gray Wolf

The gray wolf is listed as "endangered" under the Endangered Species Act. The Northern Rocky Mountain Wolf Recovery Plan defines 3 recovery zones *(USFWS 1987)*. The proposed project is in the Northwest Montana Recovery Zone.

The gray wolf is a wide-ranging, mobile species. Important aspects of habitat and successful occupancy by wolves include an adequate prey base and areas of minimal opportunity for human interaction particularly at den and rendezvous sites. Primary prey species in northwest Montana are white-tailed deer, elk, moose, and mule deer. The distribution of wolves is strongly associated with white-tailed deer winter ranges. Wolves in northwest Montana typically den in late April. Wolves choose elevated areas in gentle terrain near a water source (valley bottoms), close to meadows or other openings, and near big game wintering areas for dens and rendezvous sites.

The home ranges of the Whitefish and the Kintla Packs include some State lands in the North Fork of the Flathead River Valley. Presently, the Whitefish Pack consists of 3 adults and 1 pup, while the Kintla Pack includes 6 individuals *(T. Meier, USFWS, personal communication 2/02)*. The Whitefish Pack's home range encompasses the project area. The fire burned approximately 75 percent of the Whitefish Pack's current home range *(Moose Fire, BAER report 2001)*. The project area includes approximately 1,400 acres of elk winter range on Winona Ridge and along Cyclone Creek and 860 acres of mule deer winter range on Winona Ridge. Since the fire burned in the summer of 2001, only 1 wolf was relocated within the fire perimeter. In all other cases, wolves appear to be avoiding the burned area or using the edge, primarily in Glacier National Park. Due to the habitat conditions in the area, wolf denning and rendezvous sites are not expected to occur in the area during this project.

The timber harvest could influence wolf mortality and habitat use by displacing animals, increasing vulnerability, and affecting prey use of the area.

Direct Effects to Gray Wolves

- ***Direct Effects of No-Action Alternative A to Gray Wolves***

  No additional activities would occur in the area; thereby, no additional disturbance or potential for direct effects would be expected.

- ***Direct Effects of Action Alternative B to Gray Wolves***

  Under this alternative, 3.4 miles of new road would be constructed and another 3.4 miles of gated road would be used for transporting timber-

falling crews to harvest Unit 1SC. Minor disturbance and displacement could also occur that would be associated with logging and helicopter-yarding activities. No dens or rendezvous sites are expected in the area due to the lack of cover. In the event a den or rendezvous site is located within 1 mile of any harvest unit, activities would cease immediately and a DNRC biologist would consult with USFWS to develop appropriate mitigation measures. During the summer and autumn, wolf activity in the area might increase if ungulate use of the burned area increases. If wolf use occurred, this alternative would produce the highest level of disturbance of those considered due to road construction and human access, resulting in some displacement of prey species and wolves. The effects of displacement are expected to result in habitat shifts, but not in changes in survival or decreased reproduction. Therefore, the risks of increased mortality or decreased reproduction of wolves is minor.

- ***Direct Effects of Action Alternative C to Gray Wolves***

  This Alternative would construct of 3.4 miles of new road and use existing open roads. Minor disturbance and displacement could also occur that would be associated with logging and helicopter-yarding activities. The effects discussed in Action Alternative B are expected, but to a lesser degree. Not harvesting Unit 1SC would reduce the amount of habitat affected due to road use, thereby reducing potential for displacement over Action Alternative B. The risk of increased mortality or decreased reproduction due to disturbance of wolves is minor, and less than Action Alternative B. In the event a den or rendezvous site is located within 1 mile of any harvest unit, activities would cease immediately and a DNRC biologist would consult with USFWS to develop appropriate mitigation measures.

- ***Direct Effects of Action Alternatives D to Gray Wolves***

  This alternative would not construct any new roads; however, 3.4 miles of gated road would be opened to transport ground crews to Unit 1SC. Minor disturbance and displacement could also occur that would be associated with logging and helicopter yarding activities. The effects discussed in Action Alternative B and C are expected, but to a lesser degree due to the use of only existing road systems. The risk of increased mortality or decreased reproduction due to disturbance of wolves is minor, and less than Action Alternative B and C. In the event a den or rendezvous site is located within 1 mile of any harvest unit, activities would cease immediately and a DNRC biologist would consult with USFWS to develop appropriate mitigation measures.

- ***Direct Effects of Action Alternatives E to Gray Wolves***

  Under Action Alternative E, no additional roads would be constructed, nor would gated roads be used; therefore, no additional disturbance or increased risk of mortality to wolves resulting from road construction or use would be expected. However, minor short-term disturbance and displacement could occur that would be associated with logging and helicopter-yarding activities. Risks of increased mortality or decreased

reproduction of wolves, overall, would be expected to be minor under Action Alternatives D and E, but would be less than that anticipated under Action Alternatives B and C. In the event a den or rendezvous site is located within 1 mile of any harvest unit, activities would cease immediately and a DNRC biologist would consult with USFWS to develop appropriate mitigation measures.

Indirect Effects to Gray Wolves

- ***Indirect Effects of No-Action Alternative A to Gray Wolves***

  Under this alternative, no change in the existing condition would be expected.

- ***Indirect Effects of Actions Alternatives B, C, D, and E to Gray Wolves***

  Wolf habitat is comprised mainly of cover and access to prey. Each alternative is not expected to alter existing hiding cover or inhibit forage response that might attract ungulates to the project area. Therefore, the differences in alternatives are primarily direct and of short duration.

Cumulative Effects to Gray Wolves

- ***Cumulative Effects of No Action Alternative A to Gray Wolves***

  Human use of the area is expected to increase due to mushroom picking activities and unauthorized firewood cutting. Harvests on private and USFS land might add slightly to the disturbance in the area. Under this alternative, no additional disturbance would be expected.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Gray Wolves***

  Human use of the area is expected to increase due to mushroom picking activities and unauthorized firewood cutting. Harvests on private and USFS land might add slightly to the disturbance in the area. Harvests on USFS land would not occur concurrently with this project. These action alternatives would contribute additional disturbance as discussed above in the Direct Effects section. Cumulative risks of increased mortality or decreased reproduction of wolves overall would be expected to be minor under Actions Alternatives D and E, and would be less than that anticipated under Action Alternatives B and C.

➢ Grizzly Bear

Grizzly bears are listed as "threatened" under the Endangered Species Act. This project is proposed in grizzly bear habitat in the North Continental Divide Ecosystem Recovery Area *(USFWS 1993)*. The North Continental Divide Ecosystem is divided into subunits for analysis and management purposes. Each subunit approximates the size of a female bear home range and is separated from other subunits based on topography. This project is proposed in the State Coal Cyclone Subunit; however, the Hay Creek Subunit is located in another part of Coal Creek State Forest. Road parameters for the Hay Creek Subunit are provided in the existing condition, but are not affected by this project; therefore, no discussion of the subunit occurs in the effects analysis.

Localized effects to grizzly bears are typically considered minor and need to be viewed in the context of the cumulative effects area (such as the subunit) to assess the effects to bears. However, some specific sites, such as a suspected den on Winona Ridge, require specific management to avoid undesired effects to bears.

Cumulative effects analysis was

conducted using the State Coal Cyclone Grizzly Bear Subunit. The Moose Fire burned approximately 48 percent of the State Coal Cyclone subunit, changing the subunit from an area with abundant hiding cover to an area lacking hiding cover. Presently, State land in the State Coal Cyclone Subunit provides approximately 3,709 acres (27 percent) of hiding cover following the Cyclone Coal Timber Sale, the Cyclone Ridge Fire and salvage, the Moose Fire, and Phase I of this project. Hiding cover is mainly limited to areas that did not burn. The lack of hiding cover increases the vulnerability and disturbance factors in the subunit.

In the burned area, green-up is expected to occur earlier and big game mortality is expected to be higher than in adjacent forested stands. Additionally, several plant species affected by the fire are expected to exhibit higher nutritional levels than unburned plants. Therefore, bears are expected to use the burned areas in the spring to capitalize on the earlier forage and carrion. As the season progresses through summer, vegetation in moist areas becomes increasingly important. The reduction in tree competition is expected to result in increased moisture and the growth of associated plants, such as horsetail, in the burned area. Additionally, fireweed is expected to colonize the site, which provides bears with a source of high protein. As berry production commences in late summer and early autumn, bears switch to a heavy diet of berries. Berry-producing plants are expected to be reduced, initially, following the fire. Therefore, use of the burned area might decrease in the autumn. However, use of vegetation and travel in the burned area might still be important. In all seasons 1 year postburn, food resources in the fire area are expected to be sparse and widely distributed; therefore, bears are expected to wander throughout the area in search of food. In the near future, food sources are expected to increase and berry-producing plants are expected to respond to the fire by sprouting and producing berries within 5 years.

The amount of use the area will receive is unknown; however, bears will very likely use the burned areas in the following years. In Yellowstone National Park, *Blancard and Knight (1996)* found that females with cubs used burned habitats less than expected throughout the year, while subadult males and adult females exhibited similar use in the spring and autumn, 1 year following the 1988 fires. Adult males and subadult females showed no preference or avoidance. However, it is important to note that all these bears used the burned habitats to some degree. In subsequent years, they located bears in the burned areas in proportion to the amount of burned habitat in their home range. On the Moose Fire, several observations of grizzly bears within the fire perimeter occurred last autumn when little food was available. Use of the area is expected to continue at slightly lower to existing levels; however, the extent of use is unknown. As the burned area revegetates, the abundance of bear foods and habitat quality will increase.

Road densities provide a measure of habitat loss to grizzly bears. Since bears avoid habitats associated with roads *(Mace and Manley 1993)*, habitat loss occurs when a bear avoids using otherwise suitable habitat. To reduce risks to grizzly bears, DNRC developed a strategy to not increase the amount of road densities over levels occurring in 1996, referred

TABLE F-2 – BASELINE AND EXISTING MOTORIZED ACCESS PARAMETERS IN STATE COAL CYCLONE AND HAY CREEK SUBUNITS

ROAD PARAMETER:	OPEN (MORE THAN 1 MILE PER SQUARE MILE	TOTAL (MORE THAN 2 MILES PER SQUARE MILE	SECURITY CORE
State Coal Cyclone Subunit			
1996 Baseline (DNRC lands only)	6,914 (5,304)	4,573 (3,359)	16,183 (5,798)
% 1996 Baseline (DNRC lands only)	24.3 (38.1)	16.1 (24.5)	56.8 42.8
Existing (DRNC lands only)	6,914 (5,304)	4,478 (3,264)	16,366 (5,980)
% Existing (DNRC lands only)	24.3 38.1	15.7 (23.5)	57.5 (43.6)
Hay Creek Subunit			
1996 Baseline (DNRC lands only)	8,708 (576)	7,003 (904)	17,607 (452)
% 1996 Baseline (DNRC lands only)	28.2 (25.1)	22.7 (39.3)	57.0 (19.6)
Existing (DRNC lands only)	8,708 (576)	6,054 (101)	18,648 (1,429)
% Existing (DNRC lands only)	28.2 (25.1)	19.6 (4.4)	60.4 (61.7)

The most recent Glacier View Travel Plan Map (4/00) and DNRC information was used to refine the road layer used in this analysis. Private roads and private lands were removed from this analysis.
*** Security Core refers to the area that is 500m from an open or gated road.*

to as "baseline" levels. In several projects, DNRC took proactive steps to reduce grizzly bear habitat loss associated with roads through progressive road management *(Swede Creek Timber Sale 1995, Cyclone Coal Timber Harvest Project 1998, Cyclone Ridge 2000)*. These figures are represented in the existing condition.

Grizzly bears tend to avoid areas that exceed densities of 1 miles per square mile of open roads and 2 miles per square mile of total roads *(Mace and Manley 1993)*. Additionally, areas free of motorized disturbance are important to decrease energetic costs to grizzly bears. To measure road parameters, a moving-windows analysis *(Ake 1994)* was used. The analysis indicates that the amount of lands in the State Cyclone Coal Subunit over road densities avoided by bears are 24.3 percent (38.1 percent on State lands) in excess of 1 mile per square mile of open-road density and 16.1 percent of the subunit (24.5 percent on State lands) in excess of 2 miles per square mile of total roads* (see *TABLE F-2 – BASELINE AND EXISTING MOTORIZED ACCESS PARAMETERS IN STATE COAL CYCLONE AND HAY CREEK SUBUNITS)*. The amount of security core in the subunit is 56.8 percent (42.3 percent on DNRC lands). Managing motorized access reduces the potential for mortality, displacement from important habitats, habituation to humans, and provides relatively secure habitat to reduce the energetic requirements *(IGBC 1998)*.

Direct Effects to Grizzly Bears

- ***Direct Effects of No-Action Alternative A to Grizzly Bears***

  Under this alternative, no direct effects to grizzly bears are expected.

- ***Direct Effects of Action Alternative B to Grizzly Bears***

  Grizzlies tend to show some fidelity to denning areas, albeit not necessarily the same den *(IGBC 1987)*. If harvesting occurs in the northern area of Winona Ridge (Douglas-fir Bark Beetle Salvage Area and Units 13W, 15W, 17W) in late autumn (October through November 2002), the den-site area in this vicinity may not be used due to disturbance associated with logging activity. If logging were not to take place in late autumn 2002 and denning occurs in the area again, disturbance caused by winter harvesting several months later could cause the den to be abandoned, or cause stress to denning bears. The development of the road system into the area might facilitate snowmobile use in the area following road obliteration. Snowmobile access following timber harvesting might facilitate additional disturbance for bears for a long period of time, resulting in continued avoidance of the den *(Knight et al. 1976)*. Abandonment of a den could result in adult and/or cub mortality.

  This alternative proposes to harvest 1,311 acres and build 3.4 miles of road, resulting in approximately 5,464 acres of disturbed habitat, the largest amount of disturbance of any alternative considered under this proposal. A combination of ground-based and helicopter logging would occur. The ground-based harvesting would entail road construction and use of heavy equipment in the area, while helicopter logging (Units 13W, 24W, 28W, 7CR, and 1SC and the Douglas-fir bark beetle salvage area) would entail ground crews. The response of bears to helicopters verses ground-based harvests is unknown. Several studies recorded various responses to helicopter flights, ranging from no apparent response to fleeing *(Harding and Nagy 1980, McLellan and Shackleton 1989)*. Conversely, many studies document avoidance behavior associated with roads *(McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace et al 1997)*. Helicopter harvests would result in more direct flights, thereby limiting disturbance to the associated area. Additionally, no residual effects associated with continued motorized disturbance would be expected after helicopter yarding ceases. In either case, bears are expected to avoid the harvest unit and surrounding areas while proposed harvesting activities are taking place. Under this alternative, adjacent areas of low disturbance would not be available due to the disturbance associated with road construction and use in the security core area. This alternative also provides the highest chance of disturbance occurring throughout the area concurrently. Considering the potential direct disturbance factors associated with this alternative, a moderate to high level of risk to grizzly bears would be expected.

- ***Direct Effects of Action Alternative C to Grizzly Bears***

  Grizzlies tend to show some fidelity to denning areas, albeit not necessarily the same den *(IGBC 1987)*. If harvesting occurs in the northern area of Winona Ridge (Douglas-fir Bark Beetle Salvage Area, and Units 13W, 15W, and 17W) in late autumn (October through November 2002), the den site area in this vicinity may not be used due to

disturbance associated with logging activity. If logging were not to take place in late autumn 2002 and denning occurs in the area again, disturbance caused by winter harvesting several months later could cause the den to be abandoned, or cause stress to denning bears. The development of the road system into the area might facilitate snowmobile use in the area following obliteration. Snowmobile access following timber harvesting might facilitate additional disturbance for bears for a long period of time, resulting in continued avoidance of the den *(Knight et al. 1976)*. Abandonment of a den could result in adult and/or cub mortality.

This alternative proposes to harvest 912 acres and build 3.4 miles of road, resulting in approximately 3,691 acres of disturbed habitat. A combination of ground-based and helicopter logging would occur. The ground-based harvesting would entail road construction and use of heavy equipment in the area, while helicopter logging (Units 13W, 24W, 28W, and 7CR) would entail ground crews. The response of bears to helicopters verses ground-based harvests is unknown. Several studies recorded various responses to helicopter flights ranging from no apparent response to fleeing *(Harding and Nagy 1980, McLellan and Shackleton 1989)*. Conversely, many studies document avoidance behavior associated with roads *(McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace and Manley 1997)*. Helicopter harvests would result in more direct flights, thereby limiting disturbance to the associated area. Additionally, no residual effects associated with continued motorized disturbance would be expected after helicopter yarding ceases. In either case, bears are expected to avoid the harvest unit and surrounding areas. Under this alternative, adjacent areas of low disturbance would not be available due to the disturbance associated with road construction and use in the security core area. This alternative potentially reduces the amount of time required to complete the harvest over Action Alternative B, while reducing the overall disturbance to the area by eliminating the need to use the South Coal Road and the associated helicopter disturbance to the South Coal area. Considering the potential direct-disturbance factors associated with this alternative, a moderate level of risk to grizzly bears would be expected, but it would be lower than that anticipated under Action Alternative B.

- ***Direct Effects of Action Alternative D to Grizzly Bears***

  Grizzlies tend to show some fidelity to denning areas, albeit not necessarily the same den *(IGBC 1987)*. If harvesting occurs in the northern area of Winona Ridge (Douglas-fir Bark Beetle Salvage Area and Units 13W, 15W, and 17W) in late autumn (October through November 2002), the den-site area in this vicinity may not be used due to disturbance associated with logging activity. If logging were not to take place in late autumn 2002 and denning occurs in the area again, disturbance caused by winter harvesting several months later could cause the den to be abandoned, or cause stress to denning bears. Abandonment of a den could result in adult and/or cub mortality.

This alternative proposes to harvest 959 acres and not build any new roads, resulting in approximately 5,326 acres of disturbed habitat. In addition, 3.4 miles of gated road would be used to transport ground crews to Unit 1SC. Helicopter logging would occur on all but 4 acres. Helicopter logging would entail ground crews (fallers and choker setters). The response of bears to helicopters is unknown. Several studies recorded various responses to helicopter flights ranging from no apparent response to fleeing *(Harding and Nagy 1980, McLellan and Shackleton 1989)*. Conversely, many studies document avoidance behavior associated with roads *(McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace et al. 1997)*. Helicopter harvests would result in more direct flights, thereby limiting disturbance to the associated area. Additionally, no residual effects associated with continued motorized disturbance would be expected after helicopter yarding ceases. Bears are expected to avoid the harvest unit and surrounding areas. Under this alternative, adjacent areas of low disturbance would be available due to the lack of disturbance associated with road building and use in the security core area. However, the disturbance associated with the helicopter might render those areas marginal due to ongoing overhead disturbance for the duration of the proposed activities and uncertainty associated with responses of bears. The use of South Coal Road adds to the effects of this alternative. This alternative potentially reduces the amount of time required to complete the harvest more than under Action Alternative B or C, and most disturbance would be associated with helicopter yarding. Considering the potential direct-disturbance factors associated with this alternative, a moderate level of risk to grizzly bears would be expected, albeit lower than that anticipated for Action Alternatives B and C.

- ***Direct Effects of Action Alternative E to Grizzly Bears***

  Grizzlies tend to show some fidelity to denning areas, albeit not necessarily the same den *(IGBC 1987)*. If harvesting occurs in the northern area of Winona Ridge (Units 13W, 15W, and 17W) in late autumn (October through November 2002), the den-site area in this vicinity may not be used due to disturbance associated with logging activity. If logging were not to take place in late autumn 2002 and denning occurs in the area again, disturbance caused by winter harvesting several months later could cause the den to be abandoned, or cause stress to denning bears. Abandonment of a den could result in adult and/or cub mortality.

  This alternative proposes to harvest 560 acres and build no additional roads, resulting in approximately 3,444 acres of disturbed habitat for the duration of the project. All road activity would occur on open roads. Helicopter logging would primarily entail ground crews. The response of bears to helicopters is unknown. Several studies recorded various responses to helicopter flights, ranging from no apparent response to fleeing *(Harding and Nagy 1980, McLellan and Shackleton 1989)*. Helicopter harvests would result in more direct flights, thereby limiting disturbance to the associated area. Additionally, no residual effects associated with

continued motorized disturbance would be expected after helicopter yarding ceases. Bears would be expected to avoid the harvest units and surrounding areas. Under this alternative, adjacent areas of low disturbance would be available due to the lack of disturbance associated with road building in the security core area. However, the disturbance associated with the helicopter might render those areas marginal due to ongoing overhead disturbance for the duration of the proposed activities and uncertainty associated with responses of bears. This alternative reduces the amount of disturbance over all other action alternatives considered, and most disturbance would be associated with helicopter yarding. Considering the potential direct-disturbance factors associated with this alternative, a low level of risk to grizzly bears would be expected. Due to the type and amount of disturbance, the low potential for residual effects, and lower acreage affected, this alternative would be expected to result in considerably less risk than Action Alternatives B, C, *and D*.

Indirect Effects to Grizzly Bears

- ***Indirect Effects of No-Action Alternative A to Grizzly Bears***

  Under this alternative, no additional effects are expected.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Grizzly Bears***

  Under all action alternatives, no additional hiding cover would be removed and rejuvenation from the fire would not be affected. No additional effects are expected under Action Alternative D or E.

- ***Indirect Effects of Action Alternatives B and C to Grizzly Bears***

  Habitat loss due to road construction would occur under Action Alternatives B and C. The amount of habitat removed by the road prism would be minor compared to the potential effects associated with road disturbance. This habitat would be regained within 2 to 3 years following obliteration of the roads and revegetation. Also, these alternatives propose ground-based harvesting, which might retard the development of palatable forage, especially along skid trails. The amount of area affected by this would be extremely small compared to the amount available; therefore, any effect would be minor and result in negligible effects to grizzly bears.

Cumulative Effects to Grizzly Bears

- ***Cumulative Effects of No Action Alternative A to Grizzly Bears***

  The disturbance associated with existing open roads and adjacent habitats might increase due to mushroom picking and increased unauthorized firewood cutting in the future. The additional road use is not expected to result in additional effects to bears, since habitat along roads tends to be avoided already *(Mace and Manley 1993)*.

  Mushroom picking is expected to increase the number of people in the area and the associated disturbance. This situation is expected to increase the disturbance to grizzly bears and the chance of human conflict and potential management action. DNRC and USFS are developing a strategy to manage the situation to reduce the impacts to the resources.

- ***Cumulative Effects of Action Alternative B to Grizzly Bears***

  Under this alternative, direct cumulative disturbance would likely occur through harvesting activities and road disturbance. These disturbances are expected to cause increased energetic costs and displacement of bears from adjacent habitats. The removal of vegetation screening by the Moose Fire increases the magnitude of cumulative disturbance related to this project *(McLellan and Shackleton 1989)*.

  This alternative would provide the highest amount of disturbance to the area. The proposed road construction and use would increase the amount of area affected by open roads by 1,654 acres and total roads by 656 acres. Additionally, security core would be reduced by a minimum of 1,231 acres (*TABLE F-3 - HABITAT INFLUENCES OF PROPOSED ROADS IN THE STATE COAL CYCLONE SUBUNIT AND ON DNRC LANDS UNDER ACTION ALTERNATIVE B*). The location of the proposed Winona Ridge road segment (2.1 miles) bisects approximately 4,000 acres of security core area, resulting in 2 security core areas of approximately 1,100 acres to the south and 1,700 acres to the north. Both areas would be smaller than the recommended 2,500 acres needed to provide secure habitat *(IGBC 1998)*; therefore, it is questionable whether the remaining security core area would be effective for the duration of the project and for some unknown time after project completion. Conversely, the Dead Horse road segment (0.7 miles) is relatively benign because it is located between 2 open roads in an area that burned intensely. Grizzly bears using the area where the Dead Horse segment is proposed are currently exposed to existing disturbance along roadways; therefore, this segment is not

TABLE F-3 - HABITAT INFLUENCES OF PROPOSED ROADS IN THE STATE COAL CYCLONE SUBUNIT AND ON DNRC LANDS UNDER ACTION ALTERNATIVE B

ROAD PARAMETER:	OPEN (MORE THAN 1 MILE PER SQUARE MILE)		TOTAL (MORE THAN 2 MILES PER SQUARE MILE)		SECURITY CORE (MORE THAN 500 METERS FROM ROAD)	
	ANALYSIS AREA		ANALYSIS AREA		ANAYSIS AREA	
	SUBUNIT	DNRC	SUBUNIT	DNRC	SUBUNIT	DNRC
Analysis Based on Acreage						
Baseline	6,914	5,304	4,573	3,359	16,183	5,798
Existing	6,914	5,304	4,478	3,264	16,366	5,980
Dead Horse	6,983	5,367	4,855	3,641	16,243	5,858
Winona	6,983	5,367	4,855	3,641	16,243	5,858
Winona East	7,170	5,545	4,663	3,450	16,057	5,473
South Coal	7,688	6,078	4,478	3,264	16,366	5,980
All segments	8,568	6,937	5,134	3,920	15,135	4,820
Analysis Based on Percentage						
Baseline	24.3	38.1	16.1	24.5	56.8	42.8
Existing	24.3	38.1	15.7	23.5	57.5	43.6
Dead Horse	24.5	39.1	17.1	26.5	57.1	42.7
Winona	26.3	42.8	15.8	23.9	54.4	37.3
Winona East	25.2	40.4	16.4	25.2	56.4	41.9
South Coal	27.0	44.3	16.1	23.5	57.5	43.6
All segments	30.1	50.6	18.3	28.3	53.2	35.1

expected to further reduce bear security. The Cyclone East road segment (0.4 miles) accesses one of the few patches of live forest cover left in and around Cyclone Creek, which could affect bears by displacing them from using this cover and the surrounding area. Both the Dead Horse and Cyclone East segments could be built, used, and obliterated in 30 days or less. The short time frame concentrates use into a seasonal habitat and then removes the disturbance. The short time frame might reduce the residual avoidance effects following road obliteration. The amount of habitat disturbance resulting from each proposed road segment is displayed in *TABLE F-3 - HABITAT INFLUENCES OF PROPOSED ROADS IN THE STATE COAL CYCLONE SUBUNIT AND ON DNRC LANDS UNDER ACTION ALTERNATIVE B.*

Cumulative disturbance associated with constructing and using roads for timber-management activities would occur. Grizzly bear avoidance of roadside habitats is well documented *(McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace et al. 1997).* The construction and use of roads results in reduced habitat suitability due to associated bear displacement and avoidance. The duration of the loss does not only occur during the use of the road, but, due to learned behavior, might be extended. If adult females with cubs avoid the area, they might also teach their offspring to avoid the area *(USFWS 1995).* Since female cubs usually set up home ranges that overlap the adult female, the avoidance of the habitats are expected to last until the adult female and cubs learn that the area is again free of disturbance. The duration of this learning is unknown, but expected to exceed the duration of actual road use *(USFWS 1995).*

The avoidance of these habitats would require the animals to move to a new area to successfully meet their nutritional requirements. Since areas with forage resources are expected to be reduced, initially, due to the Moose Fire, displacement from suitable habitats adjacent to roads might not be compensated for offsite, resulting in reduced ability for animals to build fat reserves for winter survival and successful reproduction. This could lead to increased winter mortality of the individual or reduced reproductive success.

Bears use habitats adjacent to roads to some degree, but are then subject to higher energetic cost. Hiding cover in areas adjacent to roads reduces the energetic costs associated with using habitats along roads *(McLellan and Shackleton 1989).* In the areas proposed for road construction, hiding cover is sparse, resulting in long distances for animals to flee disturbance. The increased energy use and subsequent decrease in fat storage could result in decreased winter survival or depressed reproduction.

Road effects might result in avoidance/displacement to less preferred habitat, increased energetic costs, behavior/ habituation, habitat loss/ fragmentation, and/or direct mortality. The amount of displacement and the energetic costs to bears using the area are unknown. The increased roading effects are expected to result in increased energetic costs of grizzly bears using the area. Physiologically, bears are most vulnerable to increased energetic cost in the spring

while trying to recuperate from the previous winter and in the autumn while trying to maximize fat reserves for the upcoming winter. This project would increase disturbance in the late summer through the autumn season. The increased energetic cost could reduce reproductive success and/or survivability over winter. The extent of the effects are unknown, but are expected to be adverse for bears in the area and cumulative to the short-term reduction in food resources due to the Moose Fire.

The effects of the proposed alternative, coupled with reduced habitat quantity and near term quality, the expected impacts of mushroom picking, and potential for increased access of snowmobiles, especially in the spring, appear to pose a high risk of adverse effects to grizzly bears. This alternative would result in increased roading disturbance (exacerbated by the loss of hiding cover), decreased security core areas, and expected increase in human disturbance, leading to increased stress to grizzly bears using the area.

- ***Cumulative Effects of Action Alternative C to Grizzly Bears***

  The cumulative effects discussed under Action Alternative B would occur under this alternative; however, maintaining the access restriction on South Coal Road would lessen the effects. This closure would limit the amount of area influenced by open roads to an increase of 775 acres of habitat affected versus 1,654 acres that would be affected under Action Alternative B. Additionally, the Douglas-fir Bark Beetle Salvage Area, Unit 6CR, and areas in Units 27W and 13W that meet *the Green et al. (1992)* old-growth definition would not be harvested, thereby reducing the overall disturbance to the area and potentially decreasing project duration as compared to Action Alternative B (1,311 acres versus 913 acres, respectively). This alternative is expected to result in adverse cumulative effects to grizzly bears in the area for the same reasons discussed above, but to a slightly lesser degree.

- ***Cumulative Effects of Action Alternative D to Grizzly Bears***

  Under this alternative, no new roads would be constructed, but an existing gated road system would be opened to transport timber-falling crews to Unit SC1 (260 acres). The use of the gated system would result in approximately 775 acres of habitat likely to be avoided by bears because open-road densities would exceed 1 mile per square mile. This activity would occur outside the fire area on the road situated along Coal Creek. This area provides hiding cover and escape cover adjacent to the burned area where a bear might be foraging for new growth. Therefore, the increased disturbance, although localized, is expected to produce adverse effects to grizzly bears for the reasons discussed under Action Alternative B. However, the effects would be reduced due to the presence of hiding cover adjacent to the open road and security core habitat that would not be reduced.

  The effects of the proposed alternative, coupled with the expected impacts of mushroom picking, continued dispersed recreation, and a potential for increased unauthorized firewood cutting, would potentially contribute to low to moderate adverse effects to grizzly bears, albeit to a lesser degree than under Action Alternatives B

and C.

- ***Cumulative Effects of Action Alternative E to Grizzly Bears***

  Under this alternative, no changes in the road status would occur; therefore disturbance effects due to road use would not occur. However, disturbance to bears would occur by helicopter and harvesting activities for the duration of the project (4 months). Flight patterns over the security core area would be minimized and potential problems associated with roads would not occur. Project duration under this alternative would be expected to be lowest of the action alternatives considered.

  The combination of reduced habitat quantity and near-term quality in the Moose Fire perimeter and the potential for increased energetic costs result in a cumulative situation of greater risk to grizzly bears within the project and cumulative effects analysis areas. The effects of the proposed alternative, coupled with the expected impacts of mushroom picking, continued dispersed recreation, and a potential for increased unauthorized firewood cutting, would potentially contribute to adverse effects to grizzly bears, albeit to a lesser degree than under Action Alternatives B, C, and D. However, the actual extent of cumulative impacts is uncertain due to the short duration of the proposed activities and limited area affected; thus, cumulative risk to bears under this alternative is expected to be low.

SENSITIVE SPECIES

When conducting forest-management activities, the SFLMP directs DNRC to give special consideration to "sensitive" species. These species are sensitive to human activities, have special habitat requirements that may be altered by timber management, or may become listed under the Endangered Species Act if land management activities result in continued adverse impacts. Because sensitive species usually have specific habitat requirements, consideration of their needs serves as a useful "fine filter" for ensuring that the primary goal of maintaining healthy and diverse forests is met.

A search of the Montana Natural Heritage database did not return any sightings of sensitive species in or within 1 mile of the project area. Pileated woodpeckers were seen and calls were heard during field work on this project; thus, they are known to occur on the project area. *TABLE F-4 - LISTED SENSITIVE SPECIES FOR THE NORTHWEST LAND OFFICE SHOWING THE STATUS OF THESE SPECIES IN RELATION TO THIS PROJECT* lists sensitive species that were considered for analysis. These species were either included in the following analysis or were dropped from further consideration for various reasons.

➢ Black-Backed Woodpecker

The black-backed woodpecker uses burned forested stands for foraging and nesting. They forage extensively on fire-killed Douglas-fir, although other tree species are used to some degree. On average, black-backed woodpeckers forage on trees larger than 12 inches dbh relatively more than their availability *(Hejl and McFadzen 1998)*. Black-backed woodpecker forage particularly on larvae of woodboring insects, which readily invade burned stands. Additionally, insect outbreaks in unburned stands also might provide feeding opportunities *(Goggans et al. 1989)*.

Black-backed woodpeckers usually

TABLE F-4 - LISTED SENSITIVE SPECIES FOR THE NORTHWEST LAND OFFICE SHOWING THE STATUS OF THESE SPECIES IN RELATION TO THIS PROJECT

SPECIES	DETERMINATION - BASIS
Black-backed woodpecker	Included - recently (less than 5 years) burned areas occur within the project area.
Boreal owl	Included - habitat was considered present in several areas.
Coeur d'Alene Salamander	No further analysis conducted - no moist talus or streamside-talus habitat occurs in the project area.
Columbian sharp-tailed grouse	No further analysis conducted - no suitable grassland communities occur in the project area.
Common loon	No further analysis conducted - loons breed on Cyclone Lake. No harvests or associated activities that could disturb loons are planned near Cyclone Lake or would occur during the breeding season.
Ferruginous hawk	No further analysis conducted - no suitable grassland communities occur in the project area.
Fisher	Included - potential fisher habitat occurs in the project area.
Flammulated owl	No further analysis conducted - no dry ponderosa pine habitats occur in the project area.
Harlequin duck	No further analysis conducted - no potential habitat available and/or harvesting would not occur within 150 feet of potential habitat and activities would occur outside the breeding season. Harvesting is not expected to alter wood recruitment into the streams or disturb ducks during a critical time of the year.
Mountain plover	No further analysis conducted - no suitable grassland communities occur in the project area.
Northern bog lemming	No further analysis conducted - no sphagnum bogs or other fen/moss mats occur in the area.
Pileated woodpecker	Included - western larch/Douglas-fir and mixed-conifer habitats occur in the area.
Townsend's big-eared bat	No further analysis conducted - no caves or mine tunnels occur in the project area.

nest in trees that contain some heartrot. These snags, used for nesting, usually were dead before the stand-replacing fire. Recently killed trees with heartrot also provide potential nesting habitat. On average, black-backed woodpeckers use 12 to 16-inch dbh snags for nesting. Douglas-fir, western larch, and ponderosa pine are preferred species for nesting. Subalpine fir, grand fir, and Englemann spruce are used approximately in proportion to their abundance, while lodgepole pine is avoided *(Hejl and McFadzen 1998)*.

Approximately 6,753 acres of forested habitat on Coal Creek State Forest burned, with most (55 percent) burning occurring in a stand-replacement fashion. Areas that burned at stand-replacement intensity where trees in the stand averaged more than 12 inches dbh were considered potential habitat for black-backed woodpeckers.

For cumulative effects, black-backed woodpecker habitat on Coal Creek State Forest was considered. Additionally, the analysis acknowledges the remaining area (66,000 acres) within the entire Moose Fire perimeter.

Direct Effects to Black-Backed Woodpeckers

- ***Direct Effects of No-Action Alternative A***

  Under No-Action Alternative A, no additional disturbances to black-backed woodpeckers would occur.

- ***Direct Effects to Black-Backed Woodpeckers Common Action Alternatives B, C, D, and E***

  Under Action Alternatives B, C, D, and E, no substantial direct effects are expected. Under any action alternative, harvesting would occur outside of the nesting season (after July 15), therefore black-backed woodpecker nesting sites would not be affected. Some displacement might occur, but this disturbance would result in an adult bird moving to an unaffected area with little energetic cost to this mobile species. These direct effects are expected to be negligible.

Indirect Effects to Black-Backed Woodpeckers

- ***Indirect Effects of No Action Alternative A***

  The maximum amount of black-backed woodpecker habitat available (1,375 acres) would be retained. Black-backed woodpeckers would be expected to use the burned area for approximately 5 years following the fire *(Hejl and McFadzen 1998)*.

- ***Indirect Effects of Action Alternatives B and D to Black-Backed Woodpeckers***

  Under Action Alternatives B and D, salvage harvesting would occur in approximately 1,200 (17 percent) and 912 (13 percent) acres, respectively, of the 6,867 acres that burned on Coal Creek State Forest. Of these areas, approximately 247 acres provide black-backed woodpecker habitat under either alternative. Salvage logging would generally target dead and/or dying subalpine fir, Engelmann spruce, lodgepole pine, and Douglas-fir. Some dead western larch could be harvested. In all harvest units, at least 2 to 5 large snags (more than 15 inches dbh) would be retained, along with trees expected to survive the fire, unmerchantable trees/snags, and any cull trees/snags. However, as tree density would be substantially reduced in harvested units, salvaged stands would likely not be used appreciably for nesting by black-backed woodpeckers *(Hejl and McFadzen 1998)*. This reduction is not expected to affect black-backed woodpecker use of unharvested areas. The reduction in habitat is expected to result in black-backed woodpeckers shifting use to other nearby habitat that is suitable. Therefore, local adverse impacts might occur, but are expected to be minor.

- ***Indirect Effects of Action Alternative C and E to Black-Backed Woodpeckers***

  Under Action Alternatives C and E, approximately 232 acres of potential nesting habitat would be harvested. In these areas, nesting habitat would be removed, resulting in localized impacts. However, only minor adverse effects are expected due to the relatively small acreage affected and high remaining abundance of habitat that would be available within the confines of the Moose Fire perimeter.

Cumulative Effects to Black-Backed Woodpeckers

- ***Cumulative Effects of No Action Alternative A to Black-Backed Woodpeckers***

  The Moose Fire and the recent Cyclone Ridge Fire developed 1,542 acres of black-backed woodpecker habitat within Coal Creek State Forest cumulative-effects analysis area (approximately 15,000 acres). The Cyclone Ridge Fire Timber Harvest removed 104 acres and Phase I of this project removed 514 acres of habitat. Currently, 924 acres of potential black-backed woodpecker habitat exists on Coal Creek State Forest. Under No-Action Alternative A the maximum amount of available black-backed woodpecker habitat would be retained on the landscape in its present condition.

- ***Cumulative Effects to Black-Backed Woodpeckers Common to Action Alternatives B and D***

  Under either alternative, when combined with other activities on DNRC lands in the area, proposed salvage harvesting would result in reduced black-backed woodpecker habitat in the cumulative effects analysis area. Following harvesting, 677 acres of black-backed woodpecker habitat would be retained (*TABLES F-4* and *F-6 – CUMULATIVE EFFECTS SUMMARY OF BLACK-BACKED WOODPECKER HABITAT ACREAGE CREATED BY THE CYCLONE RIDGE AND MOOSE FIRES, AND MODIFIED BY DNRC'S CYCLONE RIDGE SALVAGE, MOOSE FIRE SALVAGE AND REFORESTATION PROJECT – PHASE I, AND PHASE II ALTERNATIVE B [ALTERNATIVE D]*). Delaying harvests July 15 lessens the effects of this project on nesting birds that may occupy the project area 1 year postburn. Additionally, much more potential habitat occurs on approximately 66,000 acres of the burned area outside DNRC ownership. Limited harvests might occur in these areas on private and USFS lands, though these harvests are expected to affect only a small portion of the burned area (less than 5,300 acres [USFS proposal 4,300 acres, all private lands 1,000 acres]). Localized effects in the harvest units are expected, but due to the large amounts of habitat available outside these areas, only minor effects to black-backed woodpeckers would be expected.

TABLE F-4 - CUMULATIVE EFFECTS SUMMARY OF BLACK-BACKED WOODPECKER HABITAT ACREAGE CREATED BY THE CYCLONE RIDGE AND MOOSE FIRES, AND MODIFIED BY THE DNRC CYCLONE RIDGE SALVAGE, MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE I, AND PHASE II – ACTION ALTERNATIVE B.

	DEVELOPED BY CYCLONE RIDGE FIRE	AMOUNT HARVESTED IN CYCLONE RIDGE SALVAGE	DEVELOPED BY MOOSE FIRE	AMOUNT HARVESTED IN MOOSE PHASE I SALVAGE	AMOUNT PROPOSED UNDER ALTERNATIVE B PHASE II	AMOUNT REMAINING POST TREATMENT
Severe Fire	167	104	3,784	761	560	2,526 (63.9%)
Severe Fire *(more than 12 inches average DBH)*	167	104	1,375	514	247	677 (43.9%)

TABLE F-5 - CUMULATIVE EFFECTS SUMMARY OF BLACK-BACKED WOODPECKER HABITAT ACREAGE CREATED BY THE CYCLONE RIDGE AND MOOSE FIRES, AND MODIFIED BY THE DNRC CYCLONE RIDGE SALVAGE, MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE I, AND PHASE II - ACTION ALTERNATIVE C

	DEVELOPED BY CYCLONE RIDGE FIRE	AMOUNT HARVESTED IN CYCLONE RIDGE SALVAGE	DEVELOPED BY MOOSE FIRE	AMOUNT HARVESTED IN MOOSE PHASE I SALVAGE	AMOUNT PROPOSED UNDER ALTERNATIVE C PHASE II	AMOUNT REMAINING POST TREATMENT
Severe fire	167	104	3,784	761	556	2,530 (64.0%)
Severe fire *(more than 12 inches average DBH)*	167	104	1,375	514	232	692 (44.9%)

TABLE F-6 - CUMULATIVE EFFECTS SUMMARY OF BLACK-BACKED WOODPECKER HABITAT ACREAGE CREATED BY THE CYCLONE RIDGE AND MOOSE FIRES, AND MODIFIED BY THE DNRC CYCLONE RIDGE SALVAGE, MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE I, AND PHASE II - ACTION ALTERNATIVE D

	DEVELOPED BY CYCLONE RIDGE FIRE	AMOUNT HARVESTED IN CYCLONE RIDGE SALVAGE	DEVELOPED BY MOOSE FIRE	AMOUNT HARVESTED IN MOOSE PHASE I SALVAGE	AMOUNT PROPOSED UNDER ALTERNATIVE C PHASE II	AMOUNT REMAINING POST TREATMENT
Severe fire	167	104	3,784	761	560	2,526 (63.9%)
Severe fire *(more than 12 inches average DBH)*	167	104	1,375	514	247	677 (43.9%)

TABLE F-7 - CUMULATIVE EFFECTS SUMMARY OF BLACK-BACKED WOODPECKER HABITAT ACREAGE CREATED BY THE CYCLONE RIDGE AND MOOSE FIRES, AND MODIFIED BY THE DNRC CYCLONE RIDGE SALVAGE, MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE I, AND PHASE II - ACTION ALTERNATIVE E

	DEVELOPED BY CYCLONE RIDGE FIRE	AMOUNT HARVESTED IN CYCLONE RIDGE SALVAGE	DEVELOPED BY MOOSE FIRE	AMOUNT HARVESTED IN MOOSE PHASE I SALVAGE	AMOUNT PROPOSED UNDER ALTERNATIVE E PHASE II	AMOUNT REMAINING POST TREATMENT
Severe fire	167	104	3,784	761	281	2,805 (71.0%)
Severe fire *(more than 12 inches average DBH)*	167	104	1,375	514	232	692 (44.9%)

- ***Cumulative Effects to Black-Backed Woodpeckers Common to Action Alternatives C and E***

  Proposed salvage harvesting would result in reduced black-backed woodpecker habitat in the cumulative effects analysis area (all DNRC lands contained within the Moose Fire on Coal Creek State Forest). Following harvesting, 692 acres of black-backed woodpecker habitat would be retained (*TABLES F-5* and *F-7 – CUMULATIVE EFFECTS SUMMARY OF BLACK-BACKED WOODPECKER HABITAT ACREAGE CREATED BY THE CYCLONE RIDGE AND MOOSE FIRES, AND MODIFIED BY DNRC'S CYCLONE RIDGE SALVAGE, MOOSE FIRE SALVAGE AND REFORESTATION PROJECT – PHASE I, AND PHASE II ALTERNATIVE C [ALTERNATIVE E]*). Delaying harvests until July 15 lessens the effects of this project on nesting birds that may occupy the project area 1 year postburn. Additionally, much more potential habitat occurs within the approximately 66,000 acres that occur on other ownerships. Limited harvests might occur in these areas on private and USFS lands. These harvests are expected to affect only a small portion of the burned area. Localized effects in the harvest units are expected, but due to the large amounts of habitat available outside these areas, only minor effects to black-backed woodpeckers would be expected.

➢ *Boreal Owl*

Boreal owls in Montana inhabit mature to late-successional forests at elevations from 5,000 to 8,000 feet. Nesting in the Rocky Mountains has been documented in subalpine forests dominated by subalpine fir and Engelmann spruce *(Hayward 1994)*. Such forests are structurally complex and contain high densities of large trees, shrubby and open understories, and a multilayered canopy. Boreal owls are secondary cavity-nesters, using holes excavated by pileated woodpeckers and flickers. Habitat quality depends strongly on the availability of large snags and trees with cavities suitable for nesting. Boreal owls apparently are not sensitive to human or mechanical disturbances *(Hayward 1994)*. Boreal owls have also been documented to successfully use small patches of nesting habitat (30 acres) *(Hayward 1994)*.

The project area contained approximately 442 acres of boreal nesting habitat prior to the Moose Fire. The potential habitat on Winona and Cyclone Ridge (101 acres) burned in a stand-replacing event, removing this habitat for a long period of time (100 to 150 years). The 341 acres of habitat south of Coal Creek burned in a mixed-severity event; therefore, this habitat is expected to be potentially suitable.

Direct Effects to Boreal Owls

- ***Direct Effect of No-Action Alternative A to Boreal Owls***

  No additional effects are expected under this alternative.

- ***Direct Effects to Boreal Owls Common to All Action Alternatives***

  Boreal owls appear to tolerate human disturbance and noise *(Hayward 1994)* and proposed harvests would occur outside the nesting period; therefore, no direct effects to boreal owls are expected under any action alternative.

Indirect Effects to Boreal Owls

- ***Indirect Effects of No-Action Alternative A to Boreal Owls***

  Under this alternative, no additional boreal owl habitat would be altered and all potential habitat would be retained.

- ***Indirect Effects to Boreal Owls Common to Action Alternatives B and D***

  Harvesting in Unit SC1 (260 acres) would reduce tree density, snag density, the future abundance of coarse woody debris, and forest structure, but would not necessarily eliminate boreal owl habitat. The harvesting of dead and dying trees would remove potential nest sites in the future. However, 2 to 5 large snags would be retained in the harvested area. Some trees that were expected to live at the time of marking might die in the near future, contributing to nesting habitat. Since boreal owls are not strongly territorial *(Mikkola 1983)*, several pairs could nest in this stand. Under these alternatives, harvesting on 219 acres could reduce nesting structure (snags) for use in the future when mature canopy redevelops. Reduction of nesting habitat could reduce the number of nesting pairs, resulting in decreased productivity. The effects of the reduction of short- and long-term nesting habitat are unknown, but expected to be negligible at the population level due to the bird's ability to use small isolated habitats and the existing abundance of habitat at the landscape scale in this area. This reduction is expected to result in minor short- and long-term localized effects to boreal owls.

- ***Indirect Effects to Boreal Owls Common to Action Alternatives C and E***

  Under Action Alternatives C and E, no boreal owl habitat would be harvested; therefore, no additional effects would be expected. However, reductions in snags in the harvest units might reduce habitat qualities on 93 acres in the future. The effects of the reduction of long-term nesting habitat are unknown, but are expected to be negligible at the population level due to the bird's ability to use small isolated habitats and the existing abundance of habitat at the landscape scale in this area. These alternatives result in less potential effects to boreal owls compared to Action Alternative B or D. This reduction is expected to result in minor future localized effects to boreal owls.

Cumulative Effects to Boreal Owls

- ***Cumulative Effects to Boreal Owls Common Action Alternatives B, C, D, and E***

  No previous harvesting or planned activities within the analysis area are expected to alter boreal owl habitat. The reductions in potential development of future nesting habitat are expected to be minor due to the availability of habitats developed by the Moose Fire.

➢ Fisher

Fishers are listed by DNRC as a sensitive species due to their apparent preference for late successional forests associated with riparian habitats *(DNRC 1996)*. DNRC's strategy for addressing needs of fishers is to manage for valuable resting and denning habitat near riparian areas and maintain travel

corridors.

Fishers are generalist predators and use a variety of habitat types, but are disproportionately found in stands with dense canopies *(Powell 1982, Johnson 1984)*. Fishers appear to be highly selective of resting and denning sites. In the Rocky Mountains, fishers prefer late-successional coniferous forests for resting sites and use riparian areas (within 155 feet of water) disproportionately to their availability for foraging and travel. Such areas contain large live trees, snags, and logs, which are used for resting and denning sites, and dense canopy cover, which is important for snow intercept *(Jones 1991)*. Timber harvesting and its associated road construction might affect fishers by altering habitat and/or by increasing susceptibility to trapping.

Prior to the wildfire, approximately 5,412 acres of fisher habitat existed in the project area. Presently, approximately 3,367 acres of fisher habitat is unsuitable due to the Moose Fire. The acreage of stand-replacing areas resulted in the loss of fisher habitat and barriers to fisher movement, assuming some dependency on live forest cover. In time (10 to 30 years), these stands will regenerate to provide foraging habitat for fishers. Conversely, the mixed-severity burned area might still provide habitat and/or travel corridors to edge habitats in the burned areas.

DNRC-managed lands in the State Coal Cyclone Grizzly Bear Subunit were used to analyze cumulative effects to fishers. The Moose Fire, Cyclone Ridge Fire and timber salvage, and the Cyclone Coal Timber Harvest Project altered fisher habitat in this area. In addition to the Moose Fire, the Cyclone Ridge Fire removed about 200 acres of fisher habitat, and the Cyclone/Coal Timber Harvest Project removed more fisher habitat in the uplands (42 acres). In all cases, habitat connectivity was planned and retained prior to the Moose Fire for timber sales where live trees were harvested.

Direct Effects to Fishers

- ***Direct Effects of No-Action Alternative A to Fishers***

  The Moose Fire consumed a large proportion of fisher habitat within the project area; therefore, fishers are not expected to use the area to a large extent. No-Action Alternative A would not result in any additional effects to fishers.

- ***Direct Effects to Fishers Common to All Action Alternatives***

  Since fishers are not expected to use the stand-replacement burned areas proposed for harvesting in the near term, no direct effects to fishers are expected in these areas. Some fisher use might occur in the mixed-severity harvest units. In these areas, if fishers are present during harvesting, they are expected to move out of the harvest units, resulting in slight displacement. This displacement would occur when fishers and their young are mobile; therefore, negligible effects are expected.

Indirect Effects to Fishers

- ***Indirect Effects of No-Action Alternative A***

  Under No-Action Alternative A, all snags would be retained. The larger snags might provide resting sites when canopy cover is reestablished (approximately 50 to 100 years). Additionally, dead wood would be expected to

increase in the project area through time as snags fall over, thereby increasing the amount of potential denning and resting sites in the distant future (more than 50 years). In the nearer term (10 to 30 years), foraging opportunities would return when regeneration establishes.

- ***Indirect Effects to Fishers Common to Action Alternatives B, C, D, and E***

  Under the action alternatives, harvesting snags and dead wood on the uplands would reduce the amount of structure for foraging, resting, and denning habitat in the future on 1,311 acres under Action Alternative B, 912 acres proposed for harvesting under Action Alternative C, 959 acres under Action Alternative D, and 560 acres under Action Alternative E. The closer to perennial streams, the more important the effects, since fishers prefer habitats near water *(Jones 1991)*. Under all action alternatives, no harvest units occur within 100 feet of fish-bearing streams; therefore, all trees within a 100-foot buffer along fish-bearing streams would be retained. Under Action Alternatives B and D, a 165-foot no-harvest buffer would be established on each side of a perennial stream along the west portion of Unit SC1. An existing regeneration unit that was previously harvested occurs at the lower stretch of this perennial stream before flowing into Coal Creek. This old harvest unit is regenerated enough to provide forage and travel habitat for fishers. The southern reaches of this riparian habitat burned and contain high densities of snags and coarse woody debris adequate for denning and resting. This area is expected to provide a travel corridor into the mixed-severity fire area and to provide denning and resting structure. The harvest units along fish-bearing streams generally lie on 1 side of the streams; therefore, the retention area around riparian areas might be cut down to 100 feet on 1 side of the stream, but no harvesting would occur on the opposite side of the stream. Therefore, resting structure would be retained in the riparian areas and on the unharvested upland sites. Additionally, at least 2 to 5 large (more than 15 inches dbh) snags would be retained in the harvest units. These snags are expected to provide habitat structure important for fishers and their prey as the area regenerates. The indirect effects to fishers are expected to be minor under these alternatives because the proposed project would not likely influence their current or future use of the project area substantially.

Cumulative Effects to Fishers

- ***Cumulative Effects of No Action Alternative A to Fishers***

  The fire removed 48 percent of the potential fisher habitat in the State Cyclone Coal Grizzly Bear Subunit area. On DNRC lands, approximately 3,737 acres of stand-replacement fire rendered these areas temporarily unavailable to fishers. Mixed-severity burned areas could provide potential movement corridors through intensively burned areas and access to regenerating stands in the future. As stand-replacement areas regenerate (10 to 30 years), they will develop into foraging habitat for fishers and allow movement through the area. Without removal of dead wood, large amounts of down woody

debris would accumulate over time. This accumulation would provide denning and resting sites for fishers in the future. This structure also could provide additional cover that would allow movement through the area in a shorter period of time.

- ***Cumulative Effects to Fishers Common to All Action Alternatives***

  Under Action Alternatives B, C, D, and E, dead and standing wood would be removed from the project area. The amounts vary by proposed alternative (Action Alternative B, 1,311 acres; Action Alternative C, 912 acres; Action Alternative E, 959 acres; and Action Alternative E, 560 acres). The removal of this material would reduce potential denning and resting structure mainly in the uplands. Riparian areas that are favored by fishers and other unharvested areas would retain more dead wood than in the proposed harvest units. This structure might provide adequate cover to allow movement through the area along stream corridors in a shorter period of time. Most of the existing denning and resting habitat modeled occurs outside of the fire perimeter around Cyclone Lake, Coal Creek, and the North Fork of the Flathead River. Additionally, much more potential habitat occurs on approximately 66,000 acres of burned area outside of the DNRC ownership. Limited harvesting might occur in these areas on private and USFS lands. These harvests are expected to affect only a small portion (less than 5,300 acres) of the burned area. Localized effects in the harvest units are expected, but due to the large amounts of habitat available outside these areas, minor effects to fishers would be expected.

➢ Pileated Woodpecker

Pileated woodpeckers are closely associated with mature and late successional forest communities at low to mid elevations. Pileated woodpeckers also require large snags for nesting that are also important for many other species. The pileated woodpecker plays an important ecological role by excavating cavities that are used in subsequent years by many other species of birds and mammals. Due to their important role as a keystone species and their preference for forested habitats in latter stages of successional development, DNRC considers the pileated woodpecker a sensitive species.

Pileated woodpeckers excavate the largest cavities of any woodpecker in Montana. Preferred nest trees are western larch, ponderosa pine, cottonwood, and aspen, usually 20 inches dbh and larger. Pileated woodpeckers primarily eat carpenter ants, which inhabit large downed logs, stumps, and snags. *Aney and McClelland (1985)* described pileated woodpecker habitat as "stands of 50 to 100 contiguous acres, generally below 5,000' in elevation with basal areas of 100 to 125 square feet per acre and a relatively closed canopy." The feeding and nesting habitat requirements, including large snags or decayed trees for nesting and large downed wood for feeding, closely tie these woodpeckers to mature forests with late successional characteristics. The density of pileated woodpeckers is positively correlated with the amount of dead and/or dying large wood in a stand *(McClelland 1979)*.

Potential pileated woodpecker nesting habitat was identified by searching the DNRC SLI database for old stands (more than 150 years) with more than 100 square feet per acre of basal area, more

than 40 percent canopy cover, and below 5,000 feet in elevation. Based on these parameters, approximately 1,425 acres of potential nesting habitat for pileated woodpeckers existed prior to the fire on DNRC lands within the fire perimeter, mainly in the Cyclone drainage. Approximately 879 acres of this nesting habitat burned at stand-replacement intensity, resulting in the loss of pileated nesting habitat. Mixed-severity burn areas (546 acres) and other areas with large snags, continue to provide some foraging and nesting habitat.

Cumulative effects for pileated woodpeckers on Coal Creek State Forest were analyzed. Using the above parameters, approximately 5,194 acres of pileated woodpecker nesting habitat occurred on Coal Creek State Forest in relatively large blocks prior to the Cyclone/ Coal Timber Harvest Project. This project removed 337 acres of nesting habitat in 1999, leaving 4,857 acres of nesting habitat on Coal Creek State Forest prior to the Cyclone Ridge and Moose fires. The Cyclone Ridge Fire did not remove any nesting habitat, but altered foraging habitat by removing canopy cover and increasing snag densities. The Moose Fire burned approximately 1,425 acres of nesting habitat. Of this habitat, 879 acres burned at stand-replacement intensity, while the remaining 546 acres burned at mixed-severity intensity. The stand-replacement burns removed nesting habitat by removing canopy cover, while the mixed-severity burn areas are likely to have improved habitat quality in the near future due to tree mortality and subsequent insect population increases. Currently, 3,978 acres of pileated woodpecker habitat exists on Coal Creek State Forest.

Direct Effects to Pileated Woodpeckers

- ***Direct Effects of No-Alternative A to Pileated Woodpeckers***

  No additional direct effects to pileated woodpeckers would occur under this alternative.

- ***Direct Effects to Pileated Woodpeckers Common to All Action Alternatives***

  Under all the Action Alternatives, some mortality could occur if harvests occur during nesting season due to removal of nest trees. Since harvest would occur outside the nesting period, these effects are not expected. Additionally, harvesting could displace birds. The actual effects of harvest disturbances are unknown; however, *Bull et al. (1995)* observed a marked amount of woodpecker roostings near a harvest unit consistently during harvesting operations. However, the risk of disturbance increases as the amount of area affected and duration of activity increases. Therefore, under Action Alternatives B, C, D, and E, the risk of disturbance to pileated woodpeckers decreases, respectively. Some displacement might occur; however, the effects are expected to be negligible.

Indirect Effects to Pileated Woodpeckers

- ***Indirect Effects of No-Action Alternative A to Pileated Woodpeckers***

  This alternative would retain all live trees and the snags produced by the fire. In most areas, the fire consumed the midstory canopy and opened up the overstory to varying degrees. In these areas, the regeneration of mixed-conifer species is expected. While the stands are regenerating, few to no snags would be recruited

within the stands and the current snag densities would decrease through time. If beetle populations increase, snag recruitment in the near future would also increase in the area. In the shorter period (10 to 50 years) snags would be abundant. Since pileated woodpeckers prefer high canopy cover and population density is positively correlated with snag density *(McClelland 1979)*, the area is expected to provide forage habitat in the short-term. Through time, canopy cover would increase and provide better foraging habitat and, eventually, nesting habitat, particularly associated with large larch snags. However, during this same time frame, snag densities will be decreasing. At some point (approximately 100 to 200 years), large snags will again be recruited from live trees. Therefore, pileated woodpecker nesting habitat is limited presently, but expected to increase through time.

- ***Indirect Effects to Pileated Woodpeckers Common to Action Alternatives B and D***

  The same effects as discussed above are expected to occur under these alternatives with respect to natural snag attrition and future development. In addition to these effects, 407 acres of mixed-severity burned potential nesting habitat would be harvested and snag densities would be reduced substantially in these and other proposed harvest units that might provide forage areas. In the mixed-severity areas planned for harvesting, canopy cover would not be altered appreciably, but existing snag densities and near-term recruitment would decrease. These areas would be expected to provide low- to moderate-quality nesting habitat following harvesting. In stand-replacement burned areas, foraging sites would be reduced initially. Through time, the proposed harvest units might become snag deficient due to harvesting, rendering the units unsuitable pileated woodpecker habitat until the stand is able to regenerate to a point to produce large trees and snags.

  The proposed mitigation to offset some of these effects is to retain all trees that are expected to survive, retain at least 2 to 5 large snags (more than 15 inches dbh, favoring large western larch and Douglas-fir), retain cull trees as snags (where possible), retain all trees/snags within 100 feet of a fish-bearing stream, and retain 50 percent of trees in the SMZ of non-fish-bearing streams.

  If the retained snags stand until new large snags are recruited, nesting and feeding habitat for pileated woodpeckers would be available. Conversely, if the snags that are left after logging fall before new large snags are recruited, pileated woodpecker habitat would be lost in those units. This period of time is uncertain, but could extend for several decades. The probability of snags retained through time increases with the number of snags retained. During harvesting operations, some snags might be lost due to harvesting activities and safety concerns. Postharvest, snags are vulnerable to windthrow and other weather events. To minimize losses, attempts would be made to leave clumps of snags, instead of scattered snags, in the harvest units. These techniques are expected to increase the likelihood of snags lasting for long periods of time. Under these alternatives, localized impacts could occur

due to the removal of nesting habitat.

- ***Indirect Effects to Pileated Woodpeckers Common to Action Alternatives C and E***

  No existing pileated woodpecker nesting is proposed for harvesting under these alternatives. Under these alternatives, 135 and 108 acres of potential nesting habitat burned at stand-replacing intensity and is proposed for harvesting under Action Alternatives C and E, respectively. Since the fire removed the canopy cover in these stands, they would not likely be used for nesting; however, these areas might continue to be used for foraging. In these and other areas proposed for harvesting, snag densities would be reduced substantially, resulting in a decrease in available forage sites. Under these alternatives, localized impacts could occur due to the removal of nesting habitat, but less than Action Alternatives B and D.

Cumulative Effects to Pileated Woodpeckers

- ***Cumulative Effects of No-Action Alternative A to Pileated Woodpeckers***

  No harvesting would occur, but snags along open roads would likely be removed by unauthorized firewood cutters. Foraging habitat would be retained in an unaltered condition. In mixed-severity burn areas, nesting habitat would be retained. In the longer-term, the stand-replacement burns would likely regenerate in shade-intolerant tree species and would be expected to develop into nesting habitat in the distant future (100 to 200 years). Therefore, pileated woodpeckers could continue to nest in the area in the short-term while fire-killed stands regenerate to provide long-term nesting habitat. Under this alternative, no changes in the current amount of nesting habitat would occur. Salvage harvesting on private land within the cumulative-effects analysis area might further reduce pileated woodpecker nesting habitat in the area. Harvesting on USFS could affect habitat on 4,300 acres. Taken cumulatively, only a small portion (8 percent) of the fire area would receive harvesting. Therefore, no cumulative effects resulting from this activity are anticipated.

- ***Cumulative Effects of Action Alternatives B and D to Pileated Woodpeckers***

  In addition to increased unauthorized firewood harvesting, salvage harvesting proposed under these alternatives would reduce nesting habitat quality across 407 acres that burned at mixed-severity intensity. In areas with lighter burn intensities, the retention of 2 to 5 snags per acre is expected to retain structure that could continue to provide nesting habitat, while retention of live trees would retain existing canopy cover. Prior to the Moose Fire, 4,857 acres of nesting habitat occurred on Coal Creek State Forest. The fire removed 879 acres, Moose Salvage I reduced quality on 54 acres, while these action alternatives would reduce quality on approximately 407 acres. If nesting habitat were removed, not just reduced in quality, 3,517 acres of pileated woodpecker habitat would remain on Coal Creek State Forest. Harvests on the south end of Winona Ridge would remove or reduce quality in a patch of 150 acres. This patch is small and

isolated from other habitats; therefore, the effect of losing this habitat is expected to be minimal. The harvesting proposed in Unit SC1 would affect a large block of live, existing nesting habitat on 260 acres. Large snags (2 to 5 snags/acre) would be retained in the harvest units, but whether these snags would provide suitable nesting structure on sites preferred by pileated woodpeckers is unknown. The effects of these losses are unclear, but harvesting Units 1SC and 7CR and the Douglas-fir Bark Beetle Salvage Area, which are common to both alternatives, appears to result in the highest potential to affect pileated woodpecker habitat. Under Action Alternatives B and D, in combination with other disturbances over the last 3 years (past fires and logging activities), pileated woodpecker nesting habitat decreased from 5,194 to 3,517 acres on Coal Creek State Forest. This represents a 32-percent reduction in nesting habitat and potential territories. Any further reductions in quality of habitat, particularly mixed-severity burn areas, will be additive and adverse to pileated woodpeckers in the area. The extent of these impacts is unknown due to unknown population levels in the area. Salvage harvesting on private lands within the cumulative effects analysis area might further reduce pileated woodpecker nesting habitat in the area. Harvesting on USFS land could affect habitat on 4,300 acres. Taken cumulatively, only a small portion (10 percent) of the fire area would receive harvesting. Therefore, cumulative effects resulting from this activity are anticipated to be minor.

- ***Cumulative Effects of Action Alternative C and E to Pileated Woodpeckers***

  Under Action Alternatives C and E, nesting habitat quality would be reduced by 135 and 108 acres, respectively, within stands that burned at mixed-severity intensity. In areas with lighter burn intensities, the retention of 2 to 5 snags per acre is expected to retain structure that might continue to provide nesting habitat, while retention of live trees would retain the existing canopy cover. Prior to the Moose Fire, 4,857 acres of nesting habitat occurred on Coal Creek State Forest. The fire removed 879 acres. Moose Salvage I reduced quality on 54 acres, while these alternatives would reduce quality on approximately 135 and 108 acres, respectively. If nesting habitat were removed, not just reduced in quality, 3,789 acres and 3,816 acres of pileated woodpecker habitat would remain on Coal Creek State Forest postharvest under Action Alternatives C and E, respectively. Harvests on the south end of Winona Ridge would remove or reduce quality in a patch of 150 acres. This patch is small and isolated from other habitats; therefore, the effects of losing this habitat are expected to be minimal. Under Action Alternative C and E, in combination with other disturbances over the last 3 years, pileated nesting habitat would have decreased 27 percent on Coal Creek State Forest. Any further reductions in quality of habitat, particularly mixed-severity burn areas, would be additive and adverse to pileated woodpeckers in the area. The extent of these impacts is unknown due to unknown population levels in the area. Salvage harvesting on private land within the cumulative

effects analysis area might further reduce pileated woodpecker nesting habitat in the area. Harvesting on USFS land could affect habitat on 4,300 acres. Taken cumulatively, only a small portion (9 percent) of the fire area would receive harvesting. Therefore, cumulative effects resulting from this activity are anticipated to be minor, but less than under Action Alternatives B and D.

Big Game

Winter ranges for several big game species that occur in the project area have been identified and mapped by DFWP. These include ranges used by moose, elk, and mule deer. Moose winter throughout the project area, while elk and mule deer winter along Winona Ridge, the North Fork of the Flathead River, and Coal Creek. The fire altered habitat on these winter ranges. In the areas with high amount of canopy removal by the fire, thermal cover was removed. In mixed-severity burn areas, thermal cover was reduced. In winters when the snow load is high, thermal cover is important to provide access to forage and movement of animals, especially for deer. Snow loads affect elk and moose to a lesser degree, respectively. In most areas that the fire burned, hiding cover was removed, potentially increasing vulnerability of big game species to human hunters and wild native predators. The road densities remain the same as prefire densities; however, off-road access to ATVs is higher due to the removal of vegetation. If new roads/trails are not established, this situation is expected to be short-lived (5 to 10 years). Potential increases in illegal access could further reduce big game vulnerability and, potentially, security. Forage is expected to be scant the first winter (2001/2002), while increasing in quantity and quality over the next several years. Timber-harvesting activities associated with this project could alter habitat and/or create disturbance that would adversely affect populations of elk and mule deer that use the project area. Moose are not likely to be affected by this proposal due to their ability to use open areas in the winter, and harvest levels are closely controlled through hunting permits; thus, vulnerability is a minor concern. Therefore, moose will not be analyzed further in this analysis.

Cumulative effects were analyzed on the contiguous winter ranges associated with Coal Creek State Forest for elk (15,145 acres) and mule deer (6,680 acres). On the elk winter range within Coal Creek State Forest, the fire burned 707 acres at stand-replacement intensities and 747 acres at mixed-severity intensities. In 1999, timber harvests removed approximately 181 acres of thermal cover on the elk winter range. These acres burned at severe intensities in the Moose Fire. Moose Fire Salvage and Reforestation Project - Phase I harvested 40 acres of severe-intensity burn area. On mule deer winter range, only 137 acres burned at stand-replacement intensities, while 713 acres burned at mixed-severity intensities. No harvesting under the *Cyclone/Coal Timber Project (1998)* altered mule deer winter range. Phase I of this project harvested 3 acres of severe-intensity burn area on mule deer winter range. Most of the contiguous elk and mule deer winter range outside Coal Creek State Forest also burned in this fire.

Direct Effects to Big Game

- ***Direct Effects of No-Action Alternative A to Big Game***

  No additional effects due to No-Action Alternative A are expected. The road densities remain the same as prefire densities; however, off-road access to ATVs is higher due to vegetation removal. If new roads/trails are not established, this situation is expected to be short-lived (5 to 10 years). Potential increases in illegal access could further reduce big game vulnerability and, potentially, security. Forage is expected to be scant the first winter (2001/2002), while increasing in quantity and quality over the next several years.

- ***Direct Effects to Big Game Common Action Alternatives B, C, D, and E***

  Big game use of the winter range is expected to be low during the winter of 2001/2002 due to limited regrowth of burned vegetation. Nonwinter use is expected to increase as forage production in the burned area increases. Harvesting activities and timber hauling might result in some displacement, but are not expected to result in any measurable direct effects to elk or mule deer. However, Action Alternative B is expected to cause more disturbance than Action Alternatives D, C, and E, respectively, due to the greater area affected and longer anticipated duration of disturbance.

Indirect Effects to Big Game

- ***Indirect Effects of No-Action Alternative A to Big Game***

  No-Action Alternative A would retain all dead wood in the winter-range area. Over time, these trees would fall and could inhibit travel through the area, preventing access to escape routes and access to forage. However, the coarse woody debris would prevent browsing on young conifer trees, thereby increasing the rate of hiding-cover development. This alternative would not reduce hiding or thermal cover in the project area over the reductions incurred by the fire. Through time, thermal cover is expected to decline due to residual mortality of fire-affected trees and, potentially, mortality related to insect outbreaks.

- ***Indirect Effects of Action Alternative B to Big Game***

  Under Action Alternative B, harvesting would remove primarily dead trees from 370 acres of elk and 299 acres of mule deer winter ranges and construct 3.2 miles of road. Of these acres, 233 acres burned at stand-replacement intensities on elk and mule deer winter ranges. In these areas, harvesting could increase access to forage in the near term by reducing present and future accumulations of coarse woody debris, while not reducing thermal cover. In the mixed-severity areas (179 acres), short-term losses of thermal cover could occur from harvesting. However, the trees removed would be expected to die in the near future; thereby, thermal cover would be affected similarly to harvesting. In both intensity areas, the removal of tree boles would increase sight distance slightly, resulting in slight increases in vulnerability. The construction and use of the roads would increase elk and deer vulnerability, especially during the autumn of 2002. The Winona segment influences vulnerability the most of any segment due to the current level of limited access to the Winona Ridge area. The other roads increase vulnerability, but to a lesser degree. If road obliteration is not successful in preventing motorized use or

unauthorized trails are maintained, increased vulnerability would be expected during the general big game hunting season in subsequent years. Snowmobile use in the winter could result in increased disturbance and energy expenditures for elk and deer, resulting in increased winter mortality. The harvest is not expected to reduce hiding or thermal cover appreciably; therefore, effects of Action Alternative B are expected to be minor if the road closures are effective.

- ***Indirect Effects of Action Alternative C to Big Game***

  Under Action Alternative C, harvesting would remove primarily dead trees from 306 acres of elk and 235 acres of mule deer winter ranges and construct 3.4 miles of road. Of these acres, 233 acres burned at stand-replacement intensities on elk and mule deer winter ranges. In these areas, harvesting could increase access to forage in the near-term by reducing present and future accumulations of coarse woody debris, while not reducing thermal cover. In the mixed-severity areas (73 acres), short-term losses of thermal cover could occur from harvesting. However, the trees removed would be expected to die in the near future; thereby, thermal cover would be affected similarly to harvesting. In both intensity areas, the removal of tree boles would increase sight distance slightly, resulting in slight increases in vulnerability. The construction and use of the roads would increase elk and deer vulnerability, especially during the autumn of 2002. The Winona segment influences vulnerability the most of any segment due to the current level of limited access to the Winona Ridge area. The other roads increase vulnerability, but to a lesser degree. If road obliteration is not successful in preventing motorized use or trails are maintained, increased vulnerability would be expected, especially during the general big game hunting season. Snowmobile use of the area in the winter and early spring could result in increased disturbance and energy expenditures of wintering deer and elk, resulting in increased winter mortality. Harvesting is not expected to reduce hiding or thermal cover appreciably; therefore, effects of Action Alternative C are expected to be minor if the road closures are effective.

- ***Indirect Effects of Action Alternative D to Big Game***

  Under Action Alternative D, harvesting would remove primarily dead trees from 263 acres of elk and mule deer winter ranges and no additional road construction would occur. Of these acres, 197 acres burned at stand-replacement intensities on elk and mule deer winter ranges. In these areas, harvesting could increase access to forage in the near-term by reducing present and future accumulations of coarse woody debris, while not reducing thermal cover. In the mixed-severity areas (66 acres), short-term losses of thermal cover could occur from harvesting. However, the trees removed would be expected to die in the near future; thereby, thermal cover would be affected similarly to harvesting. In both intensity areas, the removal of tree boles would increase sight distance slightly, resulting in slight increases in vulnerability. No increased vulnerability is expected due to road access. The effects of Action Alternative D are expected to minor, but less than Action Alternatives B or C.

- ***Indirect Effects of Action Alternative E to Big Game***

  Under Action Alternative E, harvesting would remove primarily dead trees from 198 acres of elk and mule deer winter range and no additional road construction would occur. All of these acres burned at stand-replacement intensities on elk and mule deer winter ranges. In these areas, harvesting could increase access to forage in the near-term by reducing present and future accumulations of coarse woody debris, while not reducing thermal cover. The removal of tree boles would increase sight distance slightly, resulting in slight increases in vulnerability. No increased vulnerability is expected due to road access. The effects of Action Alternative E are expected to be minor and less than any other proposed action alternative.

Cumulative Effects to Big Game

- ***Cumulative Effects of No-Action Alternative A to Big Game***

  Under this alternative, no additional effects are expected. Harvests on private land and USFS lands would be expected to produce minor effects to big game use of the area should salvage activities take place.

- ***Cumulative Effects to Big Game Common to All Action Alternatives***

  Since the Action Alternatives B, C, D, and E affect a small portion of the entire contiguous elk and mule deer winter ranges, the effects of all alternatives are expected to be small. Action Alternative B would affect 2.4 percent of elk winter range; Action Alternative C, 2.0 percent; Action Alternative D, 1.7 percent; and Action Alternative E, 1.3 percent. Action Alternative B would affect 4.5 percent of deer winter range; Action Alternative C, 3.5 percent; Action Alternative D, 3.0 percent; and Action Alternative E, 3.0 percent. Harvesting on private and USFS lands in the winter range considered for cumulative effects area could add to the effects of either alternative, but these effects are expected to be relatively small (less than 500 acres). The cumulative effects are expected to be minor.

  Increased roading proposed under Action Alternatives B and C might lead to increased vulnerability and disturbance in the area, especially during hunting season and winter. This disturbance might decrease survival, but to an unknown degree and would be limited to a small portion of the winter range; therefore, any cumulative effects would be minor. Other activities would occur outside the winter period (mushroom picking, firewood cutting, etc.) when habitat is abundant; therefore, no effects to deer and elk are anticipated.

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

APPENDIX G
ECONOMIC ANALYSIS

INTRODUCTION

The proposed timber salvage is the second harvest on State timberlands in Coal Creek State Forest that was burned during the summer of 2001. The salvage sale is an effort to obtain as much of the value from the burned timber as possible for the school trust fund. This appendix analyzes the economic impacts of the fire salvage sales and focuses on market activities that directly or indirectly benefit the Montana education system, generate revenue for the school trust fund, and provide funding for public buildings. The Enabling Act of 1889, as well as the State of Montana Constitution, requires that income be generated from State forestlands for the school and public buildings trusts. The analysis will center on Flathead County, where most of the impacts related to the fire salvage are likely to occur because of the well-developed wood-processing industry, including processors at all levels of production.

TABLE OF CONTENTS

Introduction 1
Flathead County 1
Alternative Direct Effects 3
Alternative Indirect Effects 4
Timber-Related Employment 7
Net Present-Value Analysis 9
Nonmarket Issues 9
Underlying Assumptions 10
Alternative Cumulative Effects 11

FLATHEAD COUNTY

The location of the Moose Fire Salvage Sale is in Coal Creek State Forest, which is situated entirely in Flathead County in Northwestern Montana. Flathead County is the fourth most populous county in Montana; only Yellowstone, Missoula, and Cascade counties are larger. The population of Flathead County in 1990 was 59,218. According to the U.S. Census Bureau, the population of Flathead County in April 2000 was 74,471, an increase of 15,253 residents over the last 10 years, implying an annual growth rate of 2.3 percent. The largest community in the county is Kalispell, with a population of over 17,000 within the community and nearly twice that many in the surrounding area. The second and third largest communities are Whitefish and Columbia Falls with populations of 6,300 and 4,300, respectively. Median age in the county is 37.2 years, making Flathead County's population slightly younger than the Montana average of 37.8.

The Montana Office of Public Instruction indicates that over 13,000 kindergarten through grade 12 school children were enrolled in Flathead County public schools in the 2000/2001 school year. Since 1991, enrollment in high school has increased more than 23 percent, to

the 2001 level of 4,369 students. Most of this growth has occurred in the Kalispell High School, where enrollment has increased by more than 500 students over the last 10 years. Elementary school enrollment is at about the same level as in 1991, 9,000 students. In the period between 1991 and 2001, elementary enrollment grew and peaked during the middle 90s, but since then has declined and is currently at 9,000 students. This trend is much the same as school trends for the rest of the country. High school enrollment is likely to drop in the next few years, as the end of children of the "baby boomers" finish their secondary education. Some of the other county high schools are already experiencing a decline in enrollment.

Flathead County is widely known for its production of "Flathead cherries" and Christmas tree farms; according to the University of Montana Bureau of Business and Economics, these and other agricultural activities account for about 8 percent of the county gross product. The wood-products industry is the largest producer in the county, accounting for about 21 percent of the County's gross product. Other areas of economic importance include transportation (16 percent), Federal government (10.1 percent), tourism (10.8 percent), and metal production (11.2 percent). The County gross product figures are substantiated by the personal income, employment, and wage and salary data.

The data in *TABLE G-1 - FLATHEAD COUNTY COVERED WAGES AND EMPLOYMENT 1999 - SELECTED INDUSTRIES* shows employment and income in different industry categories for Flathead County. Total employment shows that nearly 30,100 workers earned $697 million in wages, with an average annual wage of $23,152. The average annual wage is nearly identical to the Statewide average wage of $23,253.

TABLE G-1 - FLATHEAD COUNTY COVERED WAGES AND EMPLOYMENT 1999 - SELECTED INDUSTRIES

INDUSTRY	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGES PAID (000S)	AVERAGE WAGE
Agriculture, forestry, and fish	346	$6,750	$19,507
Forestry	44	2,176	49,490
Construction	1,855	51,308	27,659
Manufacturing	4,029	133,429	33,117
Lumber	1,911	66,071	34,574
Metals	703	27,522	39,150
Transportation	1,253	35,921	28,668
Trade	8,166	129,864	15,903
Eating and drinking establishments	2,814	26,136	9,288
Finance, insurance, and R.E.	1,473	42,639	28,946
Services	8,705	179,250	20,591
Hotels and lodging	1,237	15,840	12,805
Amusement and recreation services	741	7,921	10,690
Government	4,151	113,387	27,315
Total all industries	*30,086*	*696,559*	*23,152*

**Totals may not add due to nondisclosure of confidential industry data or to rounding.*
Source: Montana Department of Labor and Industry, Research and Analysis Bureau

Industry wages related to forest products and harvesting are paid at rates substantially above the average; only workers in the metal industry have higher annual wages per capita. The average annual wage in forestry is $49,490 or nearly 2.14 times as much as the average wage earner in Flathead County. Lumber workers earn on average $34,574 per year or nearly 50 percent more than the average wage earner. In employment terms, forestry and lumber workers account for 1,955 jobs, or about 6 percent, of the area employment. Other industries supported by tourism actually supply substantially more jobs: eating and drinking establishments, hotels and lodging, and amusement and recreation services employ 4,792 workers, nearly 16 percent of the County's wage and salary employees, or over twice as many as the forestry and lumber industries. However, wages are lower in the tourism-supported industries. The lower wage means that over twice as many workers produce less in terms of annual wage income to the County. Forestry and lumber, combined, produce $68,247,000 in annual wage income (9.8 percent of all regional wage and salary income) whereas the tourist-related industries (lodging, restaurants, and recreation) yield $50,000,000 (7.2 percent of all regional wage and salary income) in annual wage and salary income. Increases in tourist-related industries and proportional decreases in forest industries would lead to a lower average wage in Flathead County and a lowered ability for individual residents to purchase goods and services.

ALTERNATIVE DIRECT EFFECTS

- ***Effects of No-Action Alternative A***

  If No-Action Alternative A were chosen, none of the employment, income, or trust funds effects that result from the action alternatives would occur. Efforts to induce regeneration and limit the bug infestations that often occur after a fire could be more costly because of limited access. Without the income from timber sales, the State would have to fund these additional expenses from other sources.

- ***Direct Effects of Action Alternatives B***

  Action Alternative B constructs temporary roads, harvests timber in old-growth areas, harvests the largest volume of timber, and generates the largest amount of revenue for the school trust fund. This alternative also requires more road development than any other alternative and, consequently, has the highest development costs.

- ***Direct Effects of Action Alternatives C***

  Action Alternative C constructs temporary roads, but does not harvest timber in old growth areas, which reduces the available volume by over 45 percent. This alternative generates the third-largest amount of money for the school trust fund and has the second highest development costs.

- ***Direct Effects of Action Alternatives D***

  Action Alternative D harvests all units with helicopters and includes cutting in old-growth areas. This alternative cuts the second-largest amount of timber and generates the second-highest amount of revenue for the school trust fund. Development costs are low, but access points and temporary landings still need to be developed.

- ***Direct Effects of Action Alternatives E***

  Action Alternative E harvests all units with helicopters and does not harvest in areas that meet the *Greene et al* definition of old growth. Development costs are very low since most of the necessary landing sites already

exist and need little or no work to make them ready for the harvesting activities.

MARKET CONDITIONS

Stumpage prices, which are currently below the long-term average, are highly dependent on the housing market, which in turn is dependent on the interest rate. The interest rate, in part, determines who can "qualify" to purchase a home. Interest rates are currently at very low levels, which have not been seen since the late 1950's and early 1960's. These low interest rates would normally impact the housing market by stimulating new construction to satisfy the demand for housing from individuals who can now "qualify" to purchase a home. However, the economy is in a period of slow growth or possible decline. The bombing of the World Trade Center on September 11 has resulted in additional slowdown of the general economy. This means that potential homebuyers incomes are less certain and in many cases declining. Fixed or lower incomes offset some of the advantages gained through low interest rates and make it more difficult to qualify for a home mortgage. As a result housing starts are lower than would normally be the case with the low interest rates. This has resulted in timber prices at or below historical averages for the past year. The timber prices used in this analysis attempt to recognize the current market conditions.

The estimated revenues and expenditures associated with the Moose II Fire Salvage Sale are shown in *TABLE G-2—ESTIMATED REVENUES AND EXPENDITURES FROM THEMOOSE FIRE SALVAGE AND REFORESTATION PROJECT—PHASE II FOR THE ACTION ALTERNATIVES*. The different alternatives have substantially different impacts and will be discussed separately. Alternative D and E return less money to the trust because the higher logging costs result in lower stumpage prices. Similarly, alternatives C and E return lower amounts to the School Trust Fund because of the smaller volumes that result from the elimination of old growth from the sale. Nationally, market prices are "soft" due to several factors, particularly the attack on the World Trade Center, which appears to have caused a general economic slowdown. However, local demand can differ significantly compared to national demand. Consequently, the bids received for the timber may be either higher or lower than would be expected using national indicators as a basis for prediction. Since the "no action" alternative would not generate any income or additional impact on the region, it will be included in exhibits only when a comparison is needed.

ALTERNATIVE INDIRECT EFFECTS

- ***Indirect Effects of Action Alternative B***

  Action Alternative B generates the largest amount of revenue, $921,000, for the trust. It also "treats" the largest area of burned timber. *TABLE G-2 - ESTIMATED REVENUES AND EXPENDITURES FROM THE MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II FOR THE ACTION ALTERNATIVES* shows that the Forest Improvement (FI) funds are largest under this alternative. These funds are utilized to provide funding for reforestation, thinning, etc., and are utilized to aid in returning the forest to a long-term biodiverse status. The funds are also used to control various pests and diseases that can delay reforestation.

  The school trust income from Action Alternative B is estimated to be $663,000, enough to fund the education of 110 students for 1 year, based on an average cost of $6,038, as determined from information provided by the

Montana Office of Public Instruction. This information is shown in *TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S ESTIMATED REVENUE*. If the timber sale does not take place, no students are benefited. Thus, one of the "costs" of not harvesting the timber compared to harvesting under Action Alternative B is the loss of financing for 110 kindergarten through grade 12 students for a year. If the trust does not fund these students through the sale of timber, funding must come from other sources, primarily property taxes.

In addition to benefiting the schools, the revenues from the timber sale will contribute an estimated $258,000 toward public buildings under Action Alternative B. This money, distributed to the Department of Administration, then uses these funds to fund various public buildings.

- ***Indirect Effects of Action Alternative C***

Alternative C eliminates old growth from the timber harvest and, consequently, generates a lower amount of revenue, $450,000, for the trust. Since, "old growth" is not included, the amount of FI funds will also be reduced. *TABLE G-2 - ESTIMATED REVENUES AND EXPENDITURES FROM THE MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II FOR THE ACTION ALTERNATIVES* and *TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S ESTIMATED REVENUE* show the reduced amounts. Since these funds are utilized to provide funding for reforestation, thinning, etc., fewer funds will be available for these purposes under Action Alternative C.

The school trust income from Action Alternative C is estimated to be $330,000, enough to fund the education of 55 students for 1 year, based on an average cost of $6,038, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S ESTIMATED REVENUE*. If the timber sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Alternative C is the loss of financing for 55 kindergarten through grade 12 students for a year.

TABLE G-2 - ESTIMATED REVENUES AND EXPENDITURES FROM THE MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II FOR THE ACTION ALTERNATIVES

	ACTION ALTERNATIVE			
	B	C	D	E
Harvest volume (tons)	60,040	32,776	57,487	29,858
Stumpage price ($/ton)	21.28	19.15	16.28	14.01
Forest improvement (FI) fee ($)	464,134	251,845	441,720	229,424
Development costs ($)	109,750	79,750	32,250	2,500
Stumpage revenue ($)	1,285,397	627,660	935,888	418,311
State income ($)	1,749,531	879,505	1,377,608	647,734
Expenditures ($)	573,884	331,595	473,970	231,924

TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S ESTIMATED REVENUE

	ALTERNATIVE			
	B	C	D	E
Estimated trust revenue ($)	921,000	450,000	671,000	300,000
Estimated school revenue ($)	663,000	330,000	447,000	200,000
Number of students supported	110	55	74	33

In addition to benefiting the schools, the revenues from the sale will contribute an estimated $120,000 toward public buildings under Action Alternative C.

- ***Indirect Effects of Action Alternative D***

  Action Alternative D includes harvesting old growth, but utilizes helicopter logging almost exclusively. Consequently, this Action Alternative D generates a lower amount of revenue, $671,000, than Action Alternative B for 2 reasons: a reduction in the volume of timber to be harvested and an anticipated reduction in stumpage values because of the high costs associated with helicopter logging. FI funds will also be reduced from Action Alternative B levels, but, because they do not reflect a fee reduction, the loss in FI funds will be proportionately less than the reduction in trust fund revenue, i.e. the timber-harvest volume and FI fees drop by only 5 percent, but the trust fund revenue drops by 23 percent. *TABLE G-2 - ESTIMATED REVENUES AND EXPENDITURES FROM THE MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II FOR THE ACTION ALTERNATIVES* and *TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S ESTIMATED REVENUE* show the reduced amounts. Since these funds are utilized to provide funding for reforestation, thinning, etc., fewer funds will be available for these purposes under Action Alternative D than are estimated to be available under Action Alternative B.

  The school trust income from Action Alternative D is estimated to be $447,000, enough to fund the education of 74 students for 1 year, based on an average cost of $6,038, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S ESTIMATED REVENUE*. If the timber sale does not take place, no students are benefited. A "cost" of not harvesting the timber compared to harvesting under Action Alternative D is the loss of financing for 74 kindergarten through grade 12 students for a year.

  In addition to benefiting the schools, the revenues from the sale will contribute an estimated $124,000 toward public buildings under Action Alternative D.

- ***Indirect Effects of Action Alternative E***

  Action Alternative E eliminates old growth from the timber harvest and utilizes helicopter logging exclusively; consequently, compared with the 3 other action alternative, this alternative generates the least amount of revenue, $300,000, for the trust of all the alternatives. Since "old growth" is not included, the FI funds are also their lowest. *TABLE G-2 - ESTIMATED REVENUES AND EXPENDITURES FROM THE MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II FOR THE ACTION ALTERNATIVES* and *TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S ESTIMATED REVENUE* show the reduced amounts. Since these funds are utilized to provide funding for reforestation, thinning, etc., the fewest amount of funds will be available for these purposes under Action Alternative E.

  The School Trust income from Alternative E is estimated to be $200,000, enough to fund the education of 33 students for 1 year based on an average cost of $6,038, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE G-3 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR'S*

ESTIMATED REVENUE. If the timber sale does not take place, no students are benefited. A "cost" of not harvesting the timber compared to harvesting under Action Alternative E is the loss of financing for 55 kindergarten through grade 12 students for a year.

In addition to benefiting the schools, the revenues from the sale will contribute an estimated $100,000 toward public buildings under Alternative E.

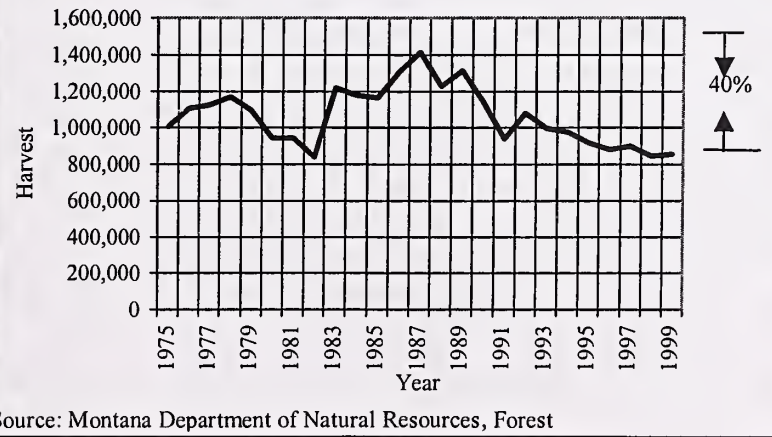
TIMBER-RELATED EMPLOYMENT

Timber harvesting generates employment. *Keegan et al* estimate that an average of 10.58 jobs are created for every MMBF of timber harvested. Both economic theory and empirical analysis suggest that the marginal effect of an increase in the timber harvested is likely to be different than the average effect because of increasing returns. The marginal effect may be larger or smaller than the average. Empirical evidence would suggest that in a growing industry, marginal effect on employment is likely to be smaller than the average. In a contracting industry, the marginal effect on employment could be either larger or smaller than the average. In most cases the marginal effect of increased or decreased timber sales is "lumpy", i. e. two sales of the same size under different conditions might induce a larger than average employment response in one case and a smaller than average, or nearly negligible, response in another.

FIGURE G-1 - TOTAL TIMBER HARVESTED FROM MONTANA FORESTS (MBF) demonstrates that the amount of timber harvested in Montana has declined since 1987. The decrease in timber harvested since the peak of 1,411 MMBF in 1987 to 854 MMBF in 1999 has been nearly 40 percent. Mills, such as American Timber Company in Olney, have recently closed, citing a lack of available timber as the cause of their foreclosure *(Missoulian, 1/12/200)*. All of these point to an industry declining in size. Based on the previous discussion, the assumption of the average induced employment of 10.58 jobs per MMBF is reasonable. Because the exact conditions of this sale are unknown, the best estimate of employment, i. e. the average effect on employment, should be used since that is the best estimate available and the marginal effect of the sale is unknown.

A ratio of 10.58 jobs per MMBF of wood harvested implies the direct generation of between 46 and 94 jobs and between $1.6 and 3.3 million for alternatives shown in *TABLE G-4 - MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II DIRECT EMPLOYMENT AND WAGE AND SALARY IMPACTS*. The wages are based on an average wage of $34,908, as derived from data in *TABLE G-1 - FLATHEAD COUNTY COVERED WAGES AND EMPLOYMENT 1999 - SELECTED INDUSTRIES*. These are the wages that directly result from the timber harvest. Without a timber harvest,

Figure 1
Total Timber Harvested From Montana Forests
(mbf)



Source: Montana Department of Natural Resources, Forest

TABLE G-4 - MOOSE FIRE SALVAGE AND REFORESTATION PROJECT - PHASE II DIRECT EMPLOYMENT AND WAGE AND SALARY IMPACTS

	ACTION ALTERNATIVE			
	B	C	D	E
Direct employment	94	51	89	46
Wages and salaries ($)	3,281,352	1,780,308	3,106,812	1,605,768

income will be lost to the State and communities. As indicated earlier, wages in the timber industry are higher than average. This allows individuals working in the industry to obtain higher than average ownership of real personal property. Since much of the revenue for school funding comes from property taxation, higher levels of real property ownership should provide for better school funding.

In addition to these jobs, additional employment is created when the income earned within the timber industry is spent to purchase goods and services elsewhere in the economy. There are also impacts from the logging companies and timber mills when they purchase goods and services from the local economy. Both of these effects are important since they support other community businesses such as grocery stores, clothing stores, gas stations, etc. The loss of the income from this sale would mean not only the loss of the direct income, but the loss of the indirect income as well.

The economic impact on schools occurs through ways other than just the direct contribution to the school trust fund from the revenue generated through timber sales. The wood industry pays taxes on the facilities it owns and operates. In the year 2000, the wood industry paid taxes in excess of $559,600 to the schools in Flathead County. The tax contribution, however, is expected to decline in 2001 with the closure of American Timber Company, which will reduce Flathead County's tax base by an estimated $4.4 million, thereby reducing the taxes received by the school districts by about $28,500. This is a permanent reduction in school funding for over 5 students per year.

Indirect economic impacts are much broader than those identified above. Some of these impacts are the result of the money from the sales "recycling" through the economy several times. For example, the money spent for groceries by the employee of the timber mill, in part, goes to pay the salary of grocery store employees, the grocery store employees use that money to purchase groceries for themselves. This in turn generates more income for the grocery store employees, etc. Unfortunately, a model of the county that could be used to make these estimates is not available. In a broader Statewide context, money paid to wood-industry workers results in increased State income tax collections, as well as increased purchases in other areas of the State. Income tax collections from the wages of millworkers alone are estimated to generate between $70,000 and $143,000 in State tax revenue; taxes on indirect wages would add to this tax amount. Since the State revenue is spent on projects Statewide, the entire State shares, in part, in the benefits that result from the timber sale. In particular, Montana schools benefit additionally by being able to use these revenues to fund schools throughout Montana.

NET PRESENT-VALUE ANALYSIS

A net present value analysis will not be developed in this research because the analysis is based on summing "discounted" costs and benefits. In this case, the 2 streams of benefits and costs will differ, primarily, by the amount of

net benefit derived from the timber sale. Future growth of the forest will not be adversely affected by the harvest and, if planting and silvicultural treatments are implemented, the restocking of the forest could be faster than if it is untreated. Mitigations are implemented to address the needs of animals that utilize elements of the burned forest. Recreational benefits might be affected slightly, but there is so much burned forest remaining nearby in this case, any benefit loss is likely to be small. Consequently, because of the positive benefit of the sale compared to the very small and possible negative benefits of not harvesting, present "net benefits" from a fire salvage sale will nearly always outweigh the present "net benefits" from not having the sale.

NONMARKET ISSUES

Quantitative analysis of the nonmarket benefits and costs will not be part of this analysis because they do not generate income for the trust, although they do affect the well-being of Montana residents. Because of their effects, a short qualitative discussion of nonmarket issues follows:

Environmental modifications - The harvesting of the timber in the burned areas will modify the undisturbed development of the forest and, as a result, will affect both the short- and long-term habitat and wildlife regeneration. The net effect of how individuals value these modifications is an empirical question and may be viewed either positively or negatively by different individuals. Modifying the undisturbed development of the burned areas will likely limit the use of the area by some species of wildlife, such as woodpeckers, in the short term and potentially limit the use by other bird species in the longer term. Some species, such as predators like the lynx, may use the area less because of the loss of cover that would be provided by downfall. Other species will use the openness associated with the harvest to their advantage and expand their use of the burned areas. Leaving some of the burned trees will help to mitigate the changes that occur because of the timber harvest, but there will be changes to the undisturbed progression of both forest and wildlife development, which will be viewed differently by different individuals. The net social benefit or loss is an empirical issue.

Human use - The harvest area has been historically used for recreational purposes such as hiking, hunting, and fishing. While the normal use of these areas is likely to decline as a result of the fires, some use may also change because of the logging that will occur. Some nonmarket uses are unlikely to change. Fishing, for example, should not be severely affected by the logging since SMZ laws protect streams. However, the visual aesthetics will be modified for individuals who would like to hike and view a burned forest as an ecological event; large areas of unlogged burned forest will remain for this purpose. Some activities may be enhanced. For instance the logged area may enhance the habitat of some game species and the increased use of areas by those game species may make the area more attractive to hunters.

SOCIAL IMPACT

Flathead County has a substantial presence in the wood-processing industry and, as a result, has institutions established to handle the social requirements associated with this industry. The Moose Fire Salvage and Reforestation Project - Phase II is unlikely to add sufficient pressures to these institutions to require their modification. Important to note,

however, is that a high rate of employment (low rate of unemployment) generates lower rates of crime, domestic violence, alcohol/drug problems, and a healthier, more satisfied community. To the extent that No-Action Alternative A might contribute to unemployment, the social impact of the harvest might be a short-term negative social impact on the community. Conversely, to the extent that the sale provides employment, the short-term impact will be positive.

PUBLIC COMMENTS

Comments received on the proposed sale were generally supportive. Some concerns were raised about the method and extent of harvesting, but in general, most of the comments from local residents were favorable, indicating that the local community generally favors the salvage logging of the burned trees. There were differences on whether trees that had some "green" remaining should be cut, and how many "snags" should be left for wildlife use. The policy for cutting trees is found in *CHAPTER II - ALTERNATIVES;* changing this policy will change the harvest volume, which, in turn, will increase or decrease the economic impact of the salvage

ROADS

A few new temporary roads are to be constructed for the salvage sales. Existing roads will be improved to handle the logging trucks and provide transport for other equipment used in salvage logging. Improvements to be made include upgrading the road surface where necessary to handle the additional truck use and replacing culverts to handle the anticipated additional run-off expect in fire-burned areas. Expenditures for road improvements are identified in each of the alternatives as part of the sale-development cost. Some improvements are also funded through FI fees, as well as other funds set up for this purpose. To the extent that these expenditures are spent locally, they will improve local economic conditions. A portion of the money will leave the area and provide income for other areas of the State and national economies. The actual culverts themselves, for example, usually come from manufacturers outside of Montana; however, most of the road-improvement expenditures will remain in Montana.

POPULATION IMPACTS

Logging and milling activities associated with the timber sale are not anticipated to have any long-term impact on the population of the region or the State of Montana.

UNDERLYING ASSUMPTIONS

Project impact estimation and analysis assumes that most of the economic impact associated with the sales will take place in the local Flathead County economy. The estimates are intended for comparative purposes and do not purport to be the value of the impacts in any absolute sense. Stumpage prices were determined using the current transaction equation modified by professional judgment to reflect current and local market conditions as much as possible.

FI fees, based on a program to provide funding for forest development and improvement, are collected from the logging company as part of their bid. Activities funded under this program include site preparation, tree planting, thinning, roadwork, right-of-way acquisition, etc. The current FI fee for the Northwest Land Office area is $52.25 per MBF.

Most of the economic impacts associated with this sale are short term. If no other trees were available for harvesting, the tendency would be to return to the previous level of economic activity.

A short-term impact that might occur as the local economy contracts might be an increase in unemployment as local employers adjust to the lowered production levels.

ALTERNATIVE CUMULATIVE EFFECTS

This sale will be part of the annual harvest of timber from the State of Montana forest trust lands. The net revenue from this sale will add to this year's contribution to the trust fund. Annual trust fund contributions have varied widely over the years, because the actual contribution to the trust is more a function of harvest than of sales. Harvest levels can vary substantially over time; sales tend to be more consistent. *TABLE G-5 – ANNUAL REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS* shows the annual revenue from harvests for the last 5 years. The net contribution to the trust fund is also affected by the annual costs experienced by the Department for program management, which varies year to year. The Department should continue to make net annual contributions to the trust from its forest management program.

DNRC resources has a Statewide sustained-yield annual harvest goal of 42.164 MMBF. If timber from this project is not sold, this volume could come from sales elsewhere; however, the timber may be from other areas and may not benefit this region of the State. The burned forest would not be available for harvest consideration again for 60 to 80 years. Consequently, harvest patterns would be impacted, changing both the region in which the trees are harvested and the volumes taken. This would impact other areas of the State where these changes occur as a result of the fire.

TABLE G-5 – ANNUAL REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS

YEAR	HARVEST REVENUE ($)
2001	8,524,150
2000	12,710,311
1999	6,998,847
1998	8,393,485
1997	7,327,641

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT

PHASE II

APPENDIX H

RECREATON AND TRAILS ANALYSIS

INTRODUCTION

The general public uses the project area for various recreational uses. Public comment regarding recreation focused upon the existing trail system in the project area.

METHODS

The methodologies used to portray the existing condition and determine the impacts this project would have on recreation included determining the recreational uses, approximating the revenue received from recreational uses, and determining the potential for conflict between timber-harvesting activities and recreational uses. The estimated dollars for comparing alternatives and making decisions may not reflect the actual returns or costs.

ANALYSIS AREA

The analysis area includes all legally accessible State land within and adjacent to the Coal Creek State Forest and the roads that would be used to haul equipment and logs.

Table of Contents

Introduction 1
Methods 1
Analysis Area 1
Existing Conditions 1
Alternative Effects 2

EXISTING CONDITION

The primary year-round dispersed recreational uses in the analysis area are hunting, firewood cutting, snowmobiling, berrypicking, and camping. While no developed recreation sites are in the project area, some dispersed sites exist along roads and near Cyclone Lake. Recreationalists fish year-round in the project area, but only in the North Fork of the Flathead River and Cyclone Lake (DFWP has closed Coal Creek and its tributaries to fishing). Dispersed recreation-use patterns will most likely change as a result of the Moose Fire, with the majority of use occurring outside the fire perimeter or where fire impacts are less noticeable. Trust revenue generated by the various recreational activities in the analysis area comes from noncommercial General Recreational Use Licenses. Annual revenue from these licenses is approximately $1,711.

Recreational and commercial mushroom gathering is expected to occur in the analysis area following the Moose Fire. Because the availability of mushrooms is dependent upon local weather, any change in potential income resulting from commercial mushroom picking and sales of General Recreational Use Permits to recreational mushroom gatherers cannot be determined.

Currently, the road system is the primary public access into the

project area. The development of roads has rendered many formerly used trails unnecessary for access purposes. Due to the Moose Fire and the lack of recent trail maintenance, trails shown on U.S. Geological Survey topographic maps in the analysis area are rarely visible on the ground. Only isolated segments of these trails were found within the Moose Fire perimeter during the initial reconnaissance. All trails in the analysis area are, generally, in an unmaintained and unusable condition. The only exception is a short segment of trail along Cyclone Creek that was cleared as an access route to the fire perimeter during fire suppression efforts.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

- ***Direct Effects Common to all Alternatives***

  Implementation of any alternative is not expected to change income amounts generated by the sale of General Recreational Use Licenses.

- ***Direct Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to affect the existing condition.

- ***Direct Effects Common to Action Alternatives B, C, D, and E***

  Due to safety concerns, timber harvest units, some road segments, and areas used for landings would be closed to recreational use during periods when road construction, timber harvesting, and log hauling occurs.

- ***Direct Effects Common to Action Alternatives B and C***

  Potentially, ground-based logging would create the loss of some blaze trees and tread over approximately 2,200 feet of historic trail in Units 17W and 18W and 2,800 feet of an historic and unmaintained trail in Unit 6CM. Temporary road construction parallel to Cyclone Creek would result in loss of tread and blaze trees on approximately 300 feet of an historic and unmaintained trail near Unit 29W.

INDIRECT EFFECTS

- ***Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not like affect the existing condition.

- ***Indirect Effects Common to Action Alternatives B, C, D, and E***

  The amount of recreational use within the project area may change. Recreational users may use adjacent areas to avoid timber-harvesting and log-hauling activities. Recreational use and the income from General Recreational Use Licenses are not expected to change during project implemention.

  The removal of down logs and potential blowdown may increase the ease of travel through harvested areas, possibly resulting in increased use by recreationalists, such as hunters and berrypickers.

CUMULATIVE EFFECTS

- ***Cumulative Effects common to All Alternatives***

  Continued deterioration of historic trails is expected to continue throughout the project area due to blown down fire-killed trees and vegetation ingrowth.

- ***Cumulative Effects of No-Action Alternative A***

  Blowdown of burnt trees would occur across the analysis area, creating barriers to off-road travel. If funds or volunteer labor were to become available for the restoration or maintenance of trails, the effects of not removing any woody material from the project area would increase the cost and difficulty of this task. Accumulation of large

amounts of blowdown may also create conditions for a reburn within the next 50 years that could further impact recreational opportunities for a longer time frame.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E***

  Tree removal would decrease the amount of blowdown and the potential for reburn in harvest units. The decreased potential for reburn would result in quicker reforestation in harvest areas, creating more desirable conditions for some recreational users. Decreased amounts of blowdown across historic trails in harvest units would make any trail restoration or maintenance less costly.

MOOSE FIRE SALVAGE AND REFORESTATION PROJECT PHASE II

APPENDIX I
SOILS ANALYSIS

INTRODUCTION

The Coal Creek valley is a U-shaped trough formed by alpine glaciation. Soil types in the main stem of Coal Creek valley are deep calcareous gravelly silt loams derived from glacial till on the lower slopes. The depth of till becomes shallower on the mid to upper slopes, giving way to residual soil weathered from bedrock on the upper slopes and ridge tops. Soils in the valley bottom are alluvial soils deposited from glacial outwash and river flows. Soils in the Cyclone Creek valley were similarly formed, but the rock materials weathered are not calcareous, which means they may not be as fertile or productive as calcareous soils.

ANALYSIS METHODS

Soil productivity will be analyzed by evaluating the current levels of soil disturbance in the proposed project area. Analysis criteria will also include soil stability risk factors.

ANALYSIS AREA

The analysis area for evaluating soil productivity will include State-owned land in Coal Creek State Forest that lies within the Moose Fire perimeter.

Table of Contents

Introduction 1
Analysis Methods 1
Analysis Area 1
Existing Conditions 1
Alternative Effects 3

EXISTING CONDITIONS

SOIL TYPES

A description of the soil types found in the proposed project area can be found in the Cyclone/Coal Timber Harvest Project EIS. Soils in the proposed project area are generally stable, and are found on moderate (20 to 40 percent) to steep (more than 40 percent) slopes.

PAST MANAGEMENT

A description of the past forest management effects, including the impacts of the Coal '99 Timber Sale Contract, on the soils in the proposed project area is found in the Cyclone/Coal Timber Harvest Project EIS.

FIRE EFFECTS

A BAER Team was formed to assess the potential effects of the Moose fire on the Coal Creek watershed. Efforts focused on identifying severely burned areas, areas with a high potential to contribute sediment to Coal Creek and the North Fork of the Flathead River, and areas where life or property was threatened by fire impacts.

The BAER Team assessed the burn severity on the Moose Fire in September, 2001. Methodology and findings of the BAER team are shown in the Team's final report. Approximately 8,000 acres of land in the Coal Creek watershed burned with

moderate or high severity. In areas with high burn severity, the fire has killed all of the trees in a stand and consumed all of the needles, most of the cones, and all of the organic duff layer on the soil. These areas will be at a higher risk of surface erosion and rilling due to the loss of ground cover. The BAER Team found no areas of imminent danger to life or property on DNRC land. Aerial seeding of grasses and forbs was prescribed for portions of Winona and Demers ridges and the ridge to the south of Coal Creek in Section 2, T33N, R21W. This seeding, prescribed to quickly establish ground-cover vegetation in areas at high risk for debris flows, is being completed in March, 2002.

Burn severity ranged from low/mosaic to severe in the proposed project area. Erosion is expected to increase substantially the first year after the fire on the severely burned sites and decline as vegetation becomes reestablished. In severely burned areas, seed sources may be limited for the reestablishment of trees. Low- and moderate-severity burned sites have some duff and roots intact that are expected to moderate runoff and erosion within the range of natural conditions. Planting of seedling stock in some of these areas would supplement natural regeneration and further reduce the erosion potential in the long term.

Hydrophobic soils were found over approximately 80 percent of the Moose Fire, including DNRC land. Two types of hydrophobicity were found in the Moose Fire:

1) an oven-drying effect occurs on volcanic ash soils where surface soil is dried to the point that it is difficult to take on moisture, and

2) a physical alteration of the soil where particles are coated with a waxy film through the burning of organic material; soil particles may begin to melt to a glassy texture.

The physical alteration of soils was only identified in isolated portions of intense fire. The type of hydrophobic condition found on State land is the oven-drying effect typically found on volcanic ash surface soils. No areas of physically altered soils were identified on State land. The type of water repellency found on the Coal Creek State Forest is the type that is typically alleviated by light rain and morning dew. The Coal Creek watershed has already seen several rain events during the fall and winter of 2001/2002, and the hydrophobic condition appears to have been largely alleviated. Precipitation is soaking into the ground well; no extreme runoff events have been observed.

Attempts to contain the Moose Fire while it was actively burning led to the construction of several miles of dozer control line in the proposed project area. These control lines were rehabilitated concurrently with suppression efforts. Many had water bars installed and large amounts of slash placed across the line. Hand constructed fireline was also rehabilitated by suppression crews, with water bars and some recontouring used to repair the disturbance.

ROADS

Road-management strategies are discussed in the Cyclone/Coal Timber Harvest Project EIS. The road improvements discussed in that EIS were either completed with the Coal '99 Timber Sale Contract or in response to the Moose Fire, with one exception: the road system south of Coal Creek in Sections 28, 29, and 30 has not been upgraded through any current activity. In addition to the road improvements listed in the Cyclone/Coal Timber Harvest Project EIS, several additional features

were installed and others upgraded in the fall of 2001 to mitigate for anticipated effects from the fire in the coming years. Culverts were designed to carry a 100-year recurrence storm. These structures are discussed in the watershed analysis.

ALTERNATIVE EFFECTS

DIRECT AND INDIRECT EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not directly affect the soil resources or stability. The direct effects of this alternative would be similar to the soil resource and soil stability conditions described under *EXISTING CONDITIONS*. Existing levels of snags would remain available for coarse woody debris recruitment to protect exposed soils and slopes. These snags would remain on site and fall as dictated by climatic conditions. Logs that fall on upper and mid slopes would provide some protection for bare soil from rilling and overland flow. These logs would also provide downed woody material for nutrient cycling.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E***

  The use of ground-based or cable yarding systems can displace and/ or compact nutrient-rich surface-soil layers. This displacement could occur in main skid trails or cable-yarding corridors, and could lead to increased erosion and decreased site productivity. These impacts would be kept to less than 20 percent of the harvest area on ground-based harvest units and less than 10 percent on cable harvest units. These impacts would be further mitigated by implementing the harvest design mitigation measures discussed on page 5.

TABLE I-1 - SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS displays the anticipated direct effects to the soil resource of each proposed action alternative. The most sensitive soils are found on wet sites and steep slopes in severe-burn areas, which would be avoided or protected with mitigation measures. Helicopter yarding would affect an estimated 5 percent or less of the area within proposed harvest units and have negligible impacts to erosion or sediment delivery. Ground effects of harvest operations would be closely monitored through sale administration. Proposed tractor harvest units would implement season-of-use and skidding restrictions to limit soil impacts. As observed on

TABLE I-10 – SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS

	ALTERNATIVE				
	A	B	C	D	E
Acres of salvage	0	1,311	912	959	561
Acres of helicopter yarding	0	516	147	955	561
Acres of cable yarding	0	107	82	0	0
Acres of tractor yarding	0	688	683	4	0
Acres trafficked by skid trails[1]	0	138	137	0.8	0
Acres in yarding corridor[2]	0	11	8	0	0
Maximum acres of soil impacted[3]	0	144	141	0.8	0
Percent of tractor and cable units impacted	0	18	18	19	0

[1]15 to 20 percent of ground-based units
[2]5 to 10 percent of cable units
[3]75 to 100 percent of skid trails and 25 to 50 percent of cable corridors

other fires *(Sula 2000, DNRC Monitoring Data 2002, McIver 2000)*, placing well-distributed coarse woody debris and broken tops on slopes can have some immediate benefit to slow surface water runoff and reduce erosion.

All of the proposed salvage units would be harvested during summer/ fall conditions. In these units, soil moisture must be less than 20 percent at a 6-inch depth for ground-based activity to take place.

Indirect effects of Action Alternatives B, C, D and E would include an expected loss of soil productivity. Displacement and compaction are expected to occur, primarily in skid trails and landings. Depending on the area and degree of impact, 10 to 20 percent of ground-based and cable yarding units would have lower productivity with the implementation of mitigation measures. Additional indirect effects of the action alternatives would include removal of future downed woody material from salvaged stands. As long as disturbance was left within established limits, placing coarse woody debris and broken tops on slopes can have some immediate benefit to slow surface-water runoff and reduce erosion as observed on other fires *(Sula 2000)*.

CUMULATIVE EFFECTS

- ***Cumulative Effect of No-Action Alternative A***

  No-Action Alternative A would have no additional cumulative effects to soil resources or stability beyond those occurring from the fire. The cumulative effects of this alternative would be similar to the soil-resource and soil-stability conditions described under *EXISTING CONDITIONS*. No previously harvested areas would be entered under this alternative, and no burned areas would be salvaged.

- ***Cumulative Effects Common to Alternatives B, C, D, and E***

  Cumulative effects to the soil resource could occur in areas previously managed; however, none of the proposed salvage units has been previously managed for timber. Moderate and severely burned sites are also a high risk for cumulative effects to soils, particularly on steep slopes over 40 percent. In these areas, special measures are necessary to protect the soil resource. The addition of well-distributed coarse woody debris and twigs could help slow surface runoff and reduce erosion on previously disturbed areas. A moderate risk of cumulative effects to soil productivity is expected, primarily in skid trails where ground-based machinery is used on sites with severe burn. Many of the proposed salvage units are located in areas with moderate- to high-burn intensity. Moderate-severity burned sites have some duff and roots intact that are expected to moderate the effects of ground skidding. On severe-burn sites, much of the duff layer is gone. Ground-based skidding in these areas would increase the risk of soil displacement and lead to a decrease in site productivity in skid trails. The mitigation measures listed below would substantially reduce the risk of adverse cumulative effects to soil productivity by limiting the area and degree of effects and placing erosion control in trails and corridors *(McIver 2000)*. Coarse woody debris would be retained to help reduce erosion and maintain nutrient cycling and long-term productivity.

HARVEST DESIGN MITIGATION MEASURES

SKIDDING LIMITATIONS

- Limit ground-based logging systems to periods when soil moisture is less than 20 percent at a 6-inch depth.
- Limit ground-based skidding to concave slopes 35 percent or less.
- Place slash and water bars in trails and corridors where needed at standard spacing.
- Skidding would be restricted in draws, wet areas, and on other sensitive soils.

SKID-TRAIL PLANNING

- The logger and sale administrator would agree to a skidding plan prior to operating equipment. Skid-trail planning would identify which main trails to use and additional trails or mitigation that may be needed. Existing trails that do not comply with BMPs (i.e. draw-bottom trails) would not be used and may be closed with additional drainage installed where needed or grass seeded to stabilize the site and control erosion.
- Skid trails would be located at least 75 feet apart.

SKYLINE YARDING

Where skyline yarding is required, log-length skidding would be used to harvest timber. The leading end of the logs would be carried free of the ground where deflection allows, except during lateral yarding. Erosion control, such as slashing or retaining tops, would be required within cable skidding corridors where excessive soil disturbance would cause erosion. The contract administrator would monitor conditions and recommend erosion control as needed.

COARSE DOWN WOODY MATERIAL

Within the harvest units, operations should retain 5 to 10 tons per acre of woody material with a diameter larger than 3 inches diameter, to be left scattered throughout the sale units. A majority of slash should be left in the harvest unit or return-skidded (concurrent with operations), as required by the forest officer to ensure distribution for erosion control. Material should be aligned predominantly perpendicular to the slope and distributed on skid trails upon completion of use. Approximately 20 submerchantable trees per acre should be felled in stands that do not have 10 to 15 tons of downed woody debris to reduce surface runoff and erosion, with priority given to slopes over 20 percent on sites of severe burn.

MOOSE FIRE SALVAGE AND REFORESTATION PHASE II PROJECT

ACRONYMS

ARM	Administrative Rules of Montana
BAER	Burned Area Emergency Rehabilitation
BMP	Best Management Practices
BMU	Bear Management Unit
C.S.	Common School Grant
DBH	Diameter at Breast Height
DEQ	Department of Environmental Quality
DFWP	Montana Department of Fish, Wildlife and Parks
DEIS	Draft Environmental Impact Statement
DNRC	Department of Natural Resources and Conservation
EA	Environmental Assessment
ECA	Equivalent Clearcut Acres
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FI	Forest Improvement
FNF	Flathead National Forest
ID Team	Interdisciplinary Team
IGBC	Interagency Grizzley Bear Committee
Land Board	Board of Land Commissioners
MBF	Thousand Board Feet
MCA	Montana Codes Annotated
MCH	Antiaggregate Pheromone
MEPA	Montana Environmental Policy Act
MMBF	Million Board Feet
NPS	National Park Service
NWLO	Northwestern Land Office
OG	Old Growth
SFLMP	State Forest Land Management Plan
SLI	Stand-Level Inventory
SMZ	Streamside Management Zone
TMDL	Total Maximum Daily Load
TPA	Trees Per Acre
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
124	Permit Stream Preservation Act Permit
3A	Authorization A—Short-term Exemption from Montana's Surface Water Quality Standards

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